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THE

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1899

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THE INFLUENCE OF ELECTRICITY UPON LOCOMOTION.

IN Great Britain and Ireland alone, says Mr. B. H. Thwaite in the *Engineering Magazine*, over a thousand million pounds sterling have been expended on steam railways. Over 1,600,000 people are directly supported by the industry. All this industry has grown from Stephenson's perseverance in compelling the use of the steam locomotive. Yet the locomotive is not a specially economical heat engine, and it is heavy—it often weighs as much as the train behind it, so that half its fuel expenditure is applied to its own propulsion. It must be heavy because it must have adhesion sufficient to draw its train, and it must carry a considerable weight of fuel and water, and there are many other objections which can be urged, such as the unbalanced effect of the moving parts. This latter especially is a serious bar to the performance of really high speeds by steam locomotives, and is rendered worse by the old-fashioned idea that even a high speed locomotive must have its cranks placed at 90° from each other. No locomotive engineer has yet dared to depart from this obviously erroneous system and to follow the lead of stationary engineers by placing both cranks the same way and employing barring engines. A steam locomotive is—except to railway directors themselves—obviously unfitted for tunnel work. Granting that the steam locomotive, as a self-contained prime mover, can never be equalled by any electrical method, the future will, nevertheless, see the newer system at the top. America, in particular, has shown how electrical railways, which elastic term includes, of course, street lines, are rapidly growing. There are now over 30,000 electric locomotors in use on 15,000 miles of line.

In Europe, so far, only 2,000 miles have been yet constructed with gradients of 10·5 per cent. on smooth rails, and 35 per cent. on rack rails. Germany, so far, has taken the lead, and France comes next. Curiously enough, England comes third only, though Mr. Thwaite claims for English practice, so far as carried out, the character of pioneer work, as exemplified on the London and Liverpool lines.

Summarising a few costs, the expenditure for coal on the Liverpool Overhead is ·02d. per ton mile. On the Manhattan (steam) the cost is ·029d., while on the Brooklyn Elevated it is ·038d., so that electricity leads by 67 per cent. Supervision costs ·014d. per ton mile at Liverpool, ·036d. on the Manhattan, and ·021d. on the Brooklyn.

Total costs are ·1245d. at Liverpool, ·190d. on the Manhattan, and ·152d. at Brooklyn.

Coal in electrical work is estimated at 2·6 lbs. per H.P.-hour. In steam work it is estimated as 3·3 for best practice, or 4·5 average, and as the locomotive is half the total load

this may be doubled to 6·6 to 9 lbs. Probably the Liverpool train-mile rate of 16 to 22½ lbs. is safer to calculate upon as against 41 lbs. for steam railways. This latter, however, is a trifle high, we fancy. The Great Northern Railway is supposed to burn only about 23 lbs. per mile on their express locomotives, and it is scarcely fair to saddle the principle of steam with the wasteful consumptions of inferior locomotives, such as the North-Western compounds.

Nevertheless, the abolition of the steam locomotive will prove an almost unmixed benefit to the structures of a line. Bridges will suffer less; so will rails and rolling stock generally. There will be no station roof corrosion from smoke acids, and electricity will greatly reduce depreciation charges generally.

Mr. Thwaite, whose work in the direction of producer gas plant for gas engines has been so successful, though it has been in a sense obscured by his own efforts in the utilisation of blast furnace gas, of which system he was the inventor and pioneer, recommends gas-driven electrical generators for main line railway work. Assuming the use of gas, from which the tar, ammonia, and hydro-carbons have been removed, there is no reason why, with allowance for the ammonia value, one tractive horse-power should not be secured for one hour by the use of three-fourths of a pound of fuel. This would mean a saving of 60 per cent. upon the cost of steam-produced electricity at Liverpool. Large gas plant has the advantage that it can be made automatically regulating to the demand for gas, comparatively small storage being necessary. A gas producer will sleep for hours, and yet can be blown into activity very quickly, and it can be made to answer quickly to fluctuations of demand.

The abject financial failure of the Metropolitan District Railways is not, as Mr. Thwaite states, wholly due to coal and steam. We agree, however, that the City and South London line is disgracefully ventilated, and that there is no excuse for the putrescent atmosphere which exists all through the tunnel, marring what should have been a fine example of an electrically-worked line.

The time has certainly come for electrical traction to be considered on any new railway. As regards the general want of progress in electrical traction in the British Isles, we very much fear that this is due at present to the unwise attitude of municipal authorities. They cannot possibly work an electric tramway as it should be worked, namely, as an integral portion of some well thought out interurban scheme.

Mere local efforts, such as are represented by such few miles as can be worked in the area of a town are not going to do everything for electrical traction or the electrical industry. Electrical traction demands a much wider field and much greater breadth of view than any local or county authority has yet been able to bring to bear upon the question. Mere urban communication is hardly needed in most small English towns, looking on them as towns only, but interurban lines are needed greatly. The steam lines of this country practically neglect interurban work altogether, for the services are too few and stations are too remote from the points chiefly sought which still lie along the old main roads. That the direct use of cheap gas will ultimately, if not very soon, be adopted for electrical work seems very certain.

The Telephone Service.

Trade and Commerce are usually bracketed together, but there are times when they can be separated. Mr. Hanbury recently received a deputation from Chambers of Commerce on the telephone question, and this deputation has been followed by one from the Chamber of Trade. "Commerce" apparently represents the aristocracy of business, and "Trade" the democracy. Commerce is not satisfied with the Government proposals on telephones; Trade is more than satisfied, and offers every encouragement to the Government to proceed with their Bill. Mr. Hanbury accorded the members of the Trade deputation a hearty reception, and intimated that he considered them of greater importance than their brethren of Commerce, since they represented the larger number of small traders amongst whom it was the desire of the Government to establish a cheap telephone service, whilst the Chambers of Commerce were content with higher prices and seemed anxious that the existing service should be purchased by the Government for the purpose of nationalising the whole system. Not so very long ago a distinction was drawn by society between wholesale and retail—a distinction which, in the present enlightened era, has been, of course, entirely abandoned. We are not desirous of seeing it revived in connection with the telephone service, and think it would be well if Mr. Hanbury were to reconsider the position. In society you may have artificial barriers; in business you cannot. Wholesale and retail are dependent on each other, and need to communicate with each other. Cheap telephones that are able to put you into communication only with the people you don't want are not cheap, and dear telephones that cannot connect you with the correspondents you are desirous of talking to are very dear indeed. A nationalised system could at least be popularised, and the aim should be borne steadily in mind; but the underlying idea in Mr. Hanbury's speeches that two systems can run together with advantage to themselves or the public, is, we think, mistaken. Sooner or later they must be merged—if one or other do not die. It would be more intelligible to take up the position of competition with the aim and object of killing, by greater efficiency or lower charges, the existing service. Such a war could not last more than 11 years, and yet it might be well to try to avoid it.

Electric Power for Marine Propulsion.—The rapid development of the applications of electricity to all kinds of purposes on land, ought not to be allowed to obscure the peculiar fitness of the same agent for the propulsion of certain classes of vessels. Mr. T. C. Child calls attention to this fact in an article in the *Engineering Magazine*, and advocates the use of accumulators for the propulsion of ferry boats and torpedo boats. The great weight and small storage capacity of accumulators are far less serious disadvantages afloat than in the case of vehicles on land, although a complete electric launch equipment weighs about 250 lbs. per horse-power, with an endurance of one hour—about four times as much as a steam power plant for the same duty; while other considerations arise which may in some cases completely turn the scale in favour of electricity. Where a number of ferry boats are employed to maintain a regular service, by charging the batteries at constant pressure at the termini, the generating plant may be kept at work under the best conditions, and an important economy effected; while in the case of torpedo boats, the necessity of speed, silence and delicacy of control makes electricity the motive power *par excellence*. The application of electricity to the propulsion of canal boats has been developed to some extent in France, but is still in a purely experimental stage; in view of our high railway rates, and the great length of canals lying almost unused in this country, the importance of a practical solution of this problem can hardly be exaggerated.

INDISPENSABLE ACCESSORIES OF ELECTRIC TRACTION.

By HENRY E. P. COTTRELL, A.M.I.C.E.

(*Continued from page* 846.)

In addition to the above control of the brake pressure effected through the cylinders, the operation of these latter is controlled by a special three-way valve worked by the brakesman, which is so adjusted that within certain limits the pressure may be altered gradually between zero and the maximum so as to give the brakesman perfect control on down gradients and in making partial stops. This controlling valve ensures the perfect lubrication of the bearing faces and the draining of accumulating moisture which might interfere with the working of the brakes in frosty weather. Fig. 38 (A, B, C, D, E, F) gives the details of this special three-way valve to which the name of engineer's brake and graduating discharge valve has been given; figs. 38A and 38B are sectional views; figs. 38C and 38D are right and left-hand top views of the complete valve, showing various positions of handle, the right-hand valve being more

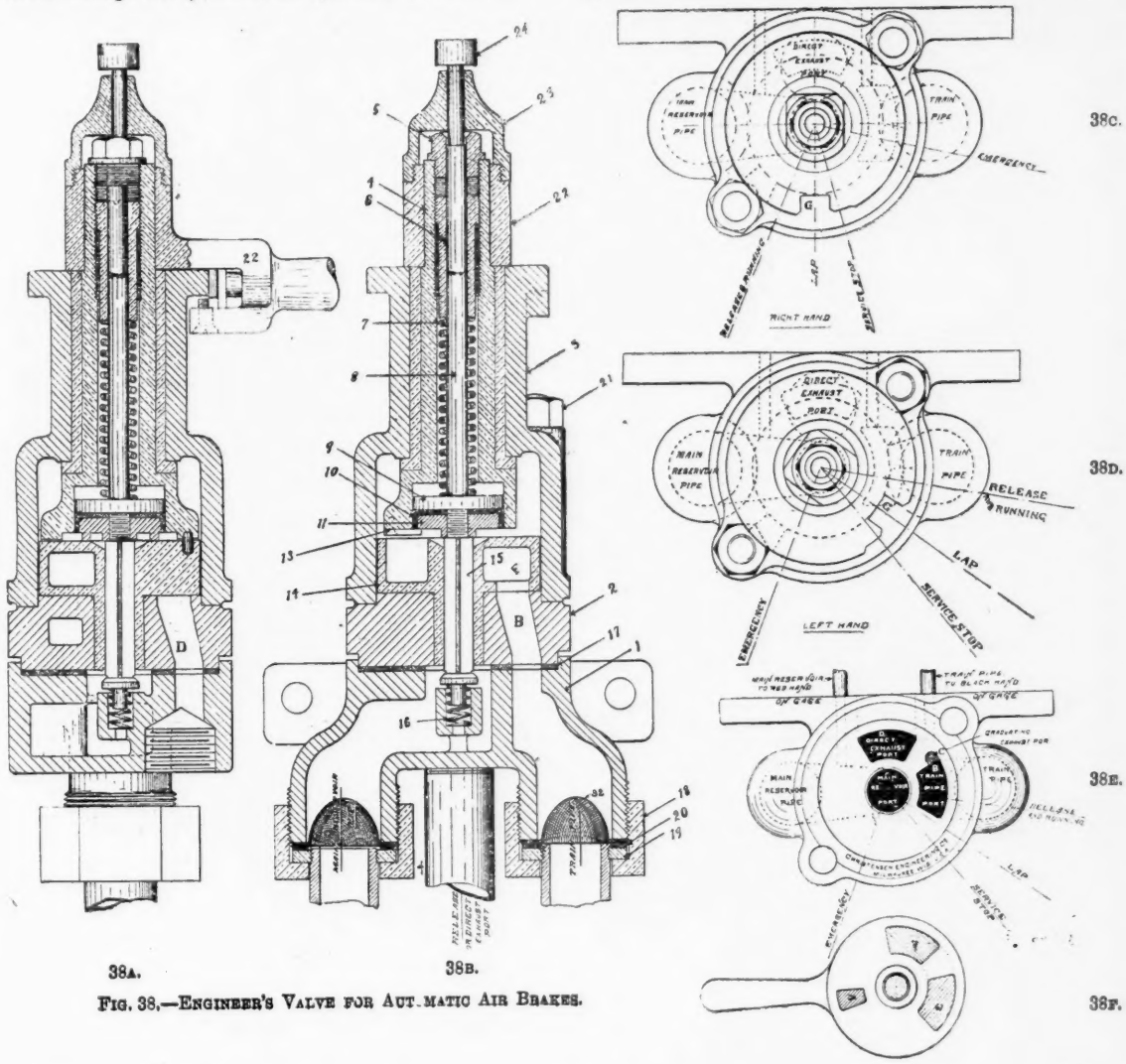


Fig. 38.—Engineer's Valve for Automatic Air Brakes.

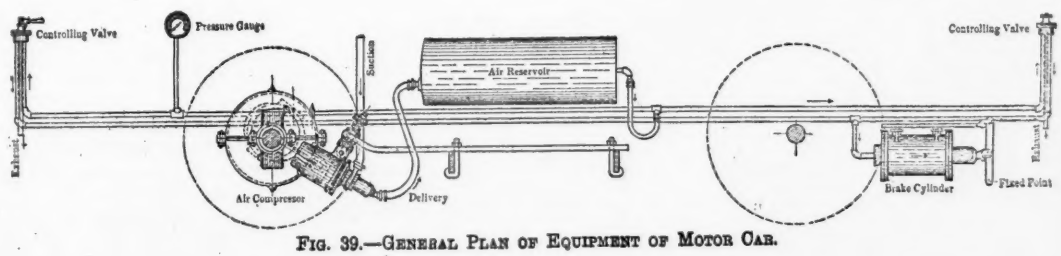


Fig. 39.—General Plan of Equipment of Motor Car.

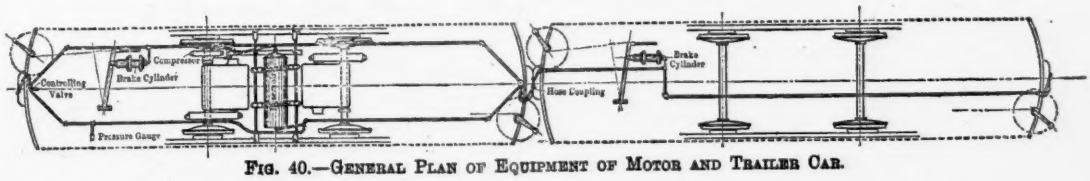


Fig. 40.—General Plan of Equipment of Motor and Trailer Car.

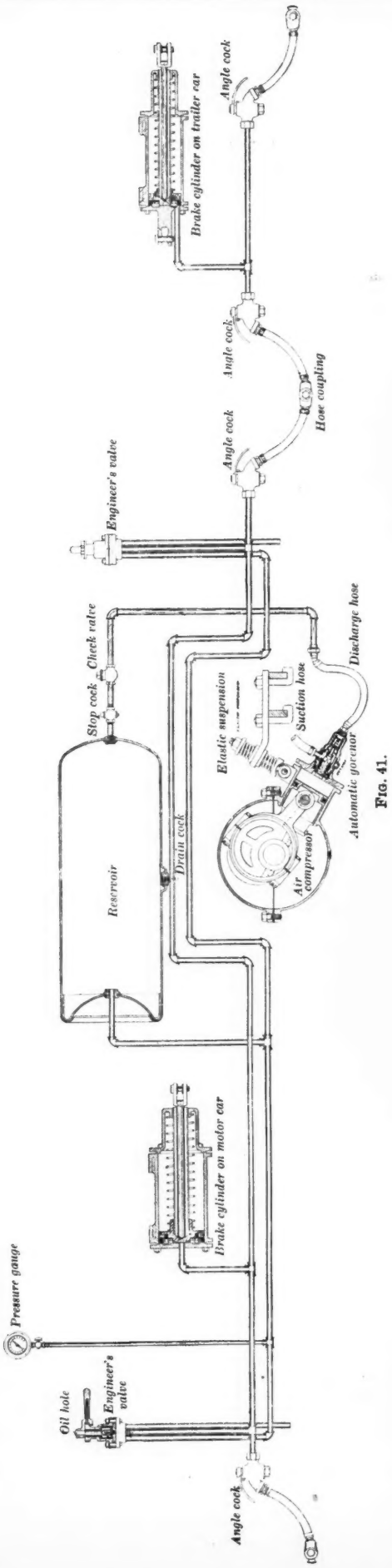


FIG. 41.

generally used; fig. 38E represents the valve with top cap removed; fig. 38F is an inverted view of the rotary disc valve, and the various parts in its face. The way the engineer's valve works is as follows (fig. 38B):—The compressed air from main reservoir enters the valve case and passes along the central aperture of the rotary disc valve, impinging against the winged valve (No. 15), which is balanced on its seat by a light spring (No. 16), but can close the lower end of the aperture in which it loosely fits.

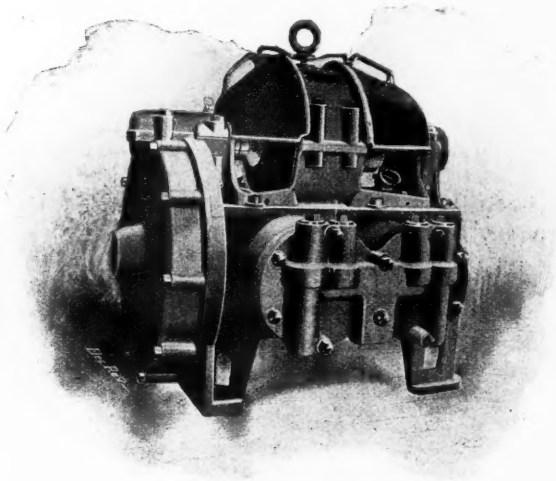


FIG. 42.

When this valve is open the air penetrates into the cavity (No. 14) above the rotary disc through the port A (fig. 38E and 38F), which coincides with port B in valve seat when valve is at "release" (the running position), and the train pipe and auxiliary reservoirs are being charged from main reservoir. The pressure continues to rise till it nears the usual limit of 70 lbs. to the square inch, when the pressure on the

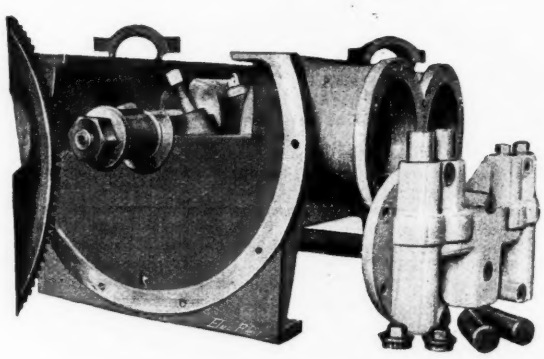


FIG. 43.

piston (No. 9) in the valve stem is sufficient to compress the spring (No. 7), which allows the regulating valve (No. 15) to close against its seat, cutting off communication between the main reservoir and the train pipe; this remains closed till the pressure in the latter is reduced by the application of the brakes or other causes. When the valve handle (No. 22) is moved from "release and running" to "lap," all communication is cut off between the ports in the rotary disc valve and its seat. At "lap" the handle can be removed, as the projection (No. 25) coincides with the notch, G, in the valve cap, and be transferred to the engineer's valve at the other end of the car. Moving the handle further to "service application," the small graduating port, C, is uncovered, and the compressed air can then escape through the port D, from the train pipe to the atmosphere, and the pressure can be slowly reduced in the latter from 6 to 8 lbs., and the brakes thus applied. The handle is then brought back to "lap" and the operation repeated, again reducing the pressure by a few

pounds for additional slight application, or it can be moved back to "release and running." By moving to "emergency" a direct communication of large area between train pipe and atmosphere is established through ports B and D in valve seat, and E and F in rotary disc, and the pressure is immediately reduced by 10 or 12 lbs., and the brakes instantaneously applied, any larger reduction in the pressure being simply wasted. By moving the handle back to "release and running," the working of all valves is reversed and the compressed air once more flows directly from main reservoir into the train pipe till the maximum limit is again attained. The spring latch on the handle enables the brakesman to feel the limits of position on valve top without looking.

Figs. 39, 40, and 41 show the adaptation of the Christensen system to a single motor car and one working with a trailer respectively. The following table gives the leading dimensions of the equipment required for various services of motor cars:—

Description.	Length. Feet.	Weight. Tons.	Speed. Miles.	Brake cylinder.	Axle compressor.	Reservoir.	Discharge hose.	Suction hose.	Check valve.	Stop cock.	General.
A.	20	8	20	5″ × 14″	5″ × 4″	14″ × 14″	½″	1¼″	½″	½″	Auto-governor
B.	24 to 30	9 to 12	25	6″ × 14″	6″ × 4″	16″ × 48″	¾″	1½″	¾″	¾″	Two engineer's valves
C.	30 to 36	12 to 18	25	7″ × 14″	7″ × 4″	16″ × 48″	1″	1½″	1″	1″	Pressure gauge
D.	36 to 45	18 to 23	25	8″ × 14″	8″ × 4″	16″ × 48″	1″	1¼″	1″	1″	

Trailer equipment in valves and brake cylinders proportioned to weight of trailer and the connections.

Speeds above 25 miles an hour and weights exceeding 23 tons would involve the required compressors being driven by gearing or independent motors. The complication introduced by gearing to reduce the piston travel is such that it materially detracts from the durability of the compressors, decreases their capacity and increases their working cost to very nearly that of the independent motor compressors, thus practically doing away with any slight advantage in first cost which the axle driven geared compressors might possess over the latter.

In the case of motor driven compressors both motor and compressor driven thereby should have all parts easily accessible for removal and repair, should be capable of continuous running for at least four months without overhauling and require no attention in service; they should be practically noiseless, and the control of the current should be automatically effected by the maximum and minimum air pressures between the working limits, with an alternative manual control. These compressors are worked off an independent crankshaft on which is mounted a gear wheel driven from a pinion on the armature of the motor, the bedplate of the motor forming the cover for the pumps. These are two in number, driven from cranks set 183° apart. The whole of the gearing is enclosed in dust-tight casing, and provision is made for self-lubrication so that the pumps can be run for five to six months without lubrication.

Figs. 42 and 43 show the general arrangement of the pumps and of the motors. The suction and discharge valves are arranged each independent of the other, so that they can be readily disconnected. The armature, gear pinion, and valves, or the cylinder covers can each be removed, without disturbing any other part of the machine.

(To be continued.)

ATLANTIC EARTH CURRENTS.

BY E. RAYMOND-BARKER.

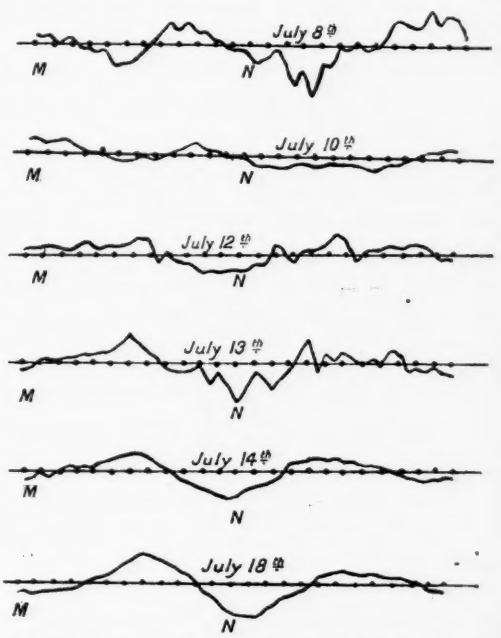
IN July, 1898, the writer, quartered in a cable hut on the shore of Massachusetts, was fortunate in having temporarily at his disposition a considerable length of submarine cable, the distant end of which was "making earth" in mid-Atlantic at a point some 1,600 N.M. distant (due East) from the United States coast.

The appeal made years ago by Lord Kelvin to cable electricians, coupled with much personal interest in the subject of earth currents, prompted the writer to organise a continuous day-and-night record of earth current observations on the afore-mentioned cable.

Thanks, in great part, to the efficient and valued collaboration of four assistants, an interesting set of readings, covering some 16 days, was obtained. Corresponding curves* were plotted out by the writer.

Variations more or less erratic were apparent during the first seven days (July 7th—13th) of observation. This period of time, however, was followed by five days (July 14th—18th) during which a striking regularity of variation was maintained. The corresponding curves for these five days are almost parallel, as well as uniform in their chief characteristic of changing in *sign* four times every 24 hours.

In fact, the curves for the five days in question may be taken as representing normal conditions of earth currents across the North Atlantic region, and they are instructive in so far as they show at what period of the day and night the cables are most likely to be free from disturbance; for even if the times of *zero* and of *maximum* potential be slightly progressive, the knowledge of a *zero* time on any particular day would practically acquaint one with earth current conditions for several days following.



Earth current curves obtained through nearly 1,600 N.M. of cable. Cable laid approximately west-east. Both ends of cable to earth.

Knowledge as to these conditions is of great practical use to cable officials, who, anxious not to waste valuable time, aim at making their routine electrical tests at hours most likely to be favourable to efficient execution and reliable results.

The following table is derived from the July 14th—18th curves:—

* We give a few of these curves only.—EDS. ELEC. REV.

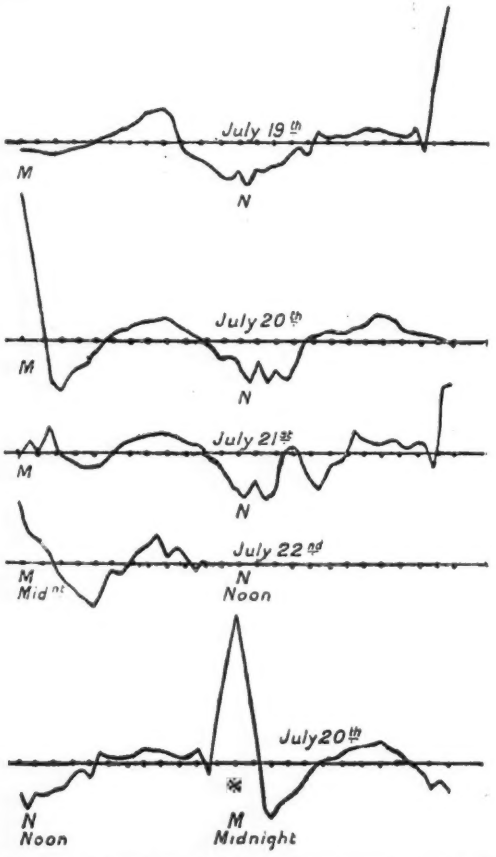
Date (1898).	24 hours.							
	Zero.	Maximum (negative).	Zero.	Maximum (positive).	Zero.	Maximum (negative).	Zero.	Maximum (positive).
	a.m.	a.m.	a.m.		p.m.	p.m.	p.m.	
July 14	1.55	6.15	8.15	11.30 a.m.	2.35	5.0	10.30	11.0 p.m.
„ 15	2.55	6.45	8.50	11.40 „	2.50	6.0	9.0	0.0
„ 16	1.10	6.10	8.0	11.30 „	2.20	5.10	8.0	11.0 p.m.
„ 17	1.50	6.30	9.25	0.30 p.m.	4.5	7.0	9.50	0.0
„ 18	3.50	7.0	10.0	1.0 „	4.30	7.0	10.30	1.0 a.m.

The times given in the table are all *local*, and five hours behind Greenwich civil time.

The culminating point of interest in these observations lay in the remarkably high voltage which declared itself on the night of July 19th—20th, and which, at midnight (*local*) or 5 a.m. *Greenwich* (July 20th), attained 33 volts.

The curves of the latter half of July 19th, and of the first 12 hours of July 20th, have been repeated in the diagram, so as to show this remarkable "peak" entire, and in the centre of a 24 hours' series.

The rate of gradual ascent and descent of the peak, of which the formation covered about 2½ hours, was without the slightest apparent irregularity, and the back-swing across zero, soon after 1 a.m., covered over three hours.



N.B.—Times given refer to station of observation at western end of cable [approx. 5 hours behind Greenwich] * M (midnight) equivalent to 5 a.m. (approx.) Greenwich civil time.

The 33-volt peak followed by this back-swing impressively suggests the idea of momentum of heavy mass in motion—perhaps a subterranean displacement of igneous molten matter.

All climatic, meteorological and tidal conditions at the station of observation, at the time in question, were normal.

Curiously enough, the following midnight (July 20th—21st) a lesser peak (*maximum* 16 volts) covering nearly three hours, declared itself.

Suggestions as to a true interpretation of these telluric variations would be of interest, and are invited by the writer.

Thanks to the kind co-operation of the Astronomer Royal and Mr. W. C. Nash, of the Magnetic and Meteorological Department, Greenwich, also of Dr. Charles Chree, F.R.S., superintendent of Kew Observatory, of Mons. S. Guillaume, secretary of the Bureau Central Météorologique, Paris, and of Father Walter Sidgreaves, S.J., director of Stonyhurst College Observatory, Lancashire, the magnetic curves for the time coinciding with that at which the 33-volt peak was observed on the United States coast have been obtained.

These magnetic curves comprise times (July 20th) 2 a.m. to 8 a.m. Greenwich civil time.

A distinct variation from the normal magnetic record is found to declare itself, the maximum disturbance approximating to 5 a.m., that is to say, it is synchronous with the American earth current peak culminating at midnight July 19th—20th, New York time.

This irregular variation is naturally more pronounced on the curves of declination, and of horizontal force than it is on those of vertical force.

The Greenwich earth current curves from two aerial lines, respectively 3 miles (N.E. to S.W.) and 2½ miles (S.E. to N.W.) are also interesting, and afford evidence of abnormal disturbance. Incidentally a point of interest is emphasised by the discontinuation of the Greenwich earth current curve record soon after 6 a.m. After this hour the curves are thrown into violent vibration, and their efficiency as records destroyed by electrical disturbance due to the passage of trains on the South London (Electric) Railway.

Great interest also lies in the practically perfect coincidence of the magnetic curves recorded at the various observatories.

THE TRANSMISSION OF PICTURES BY TELEGRAPHY.

An instrument designed by Mr. Ernest A. Hummel has recently been successfully employed in America to transmit recognisable portraits over lines exceeding 1,500 miles in length. The principle on which the instrument is constructed involves the employment of a sending and receiving

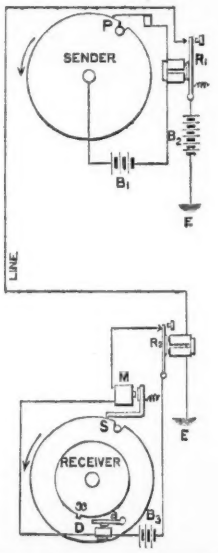


Fig. 1.—Diagram of Connections. The Tele diagraph.

cylinder rotating at nearly the same rate. The cylinders are rotated by clockwork, but the receiving cylinder moves slightly faster than the sending one. The result of this is, that the receiving cylinder completes a revolution a little earlier than the sending cylinder. The receiving cylinder is arrested at the end of a revolution by a stop, which is released by a current, sent by the sending cylinder when it catches it up. The cylinders are thus exactly synchronised each revolution without the use of a special synchronising current.* The arrangement of the circuits is shown in fig. 1. The drawing

* A precisely similar arrangement to this, it may be mentioned, was used in the d'Arlincourt Autographic Telegraph (Electrical Review, January 15th, 1879).

to be transmitted is drawn in insulating ink on tinfoil, which is wrapped round the cylinder of the sender. A local circuit contains a battery, B_1, a platinum point, P, which presses on the tinfoil and is carried by a traversing slide such as is used in a screw-cutting lathe, and a magnet, R_1, capable of closing the line circuit. At the receiving end the relay, R_2, works "backwards," *i.e.*, it breaks the local circuit when a current is flowing in the line. The tracer point, S, is thus pressed down, only when the point, P, is passing over the insulating ink. The magnetic stop, D, is released when the point, P, passes over the gap at the end of the sheet of tinfoil on the sending cylinder, thus synchronising the cylinder in a very simple manner.

A portrait received in New York from St. Louis over 1,550 miles of line and through one repeater, half full size, without re-touching.

FIG. 2.

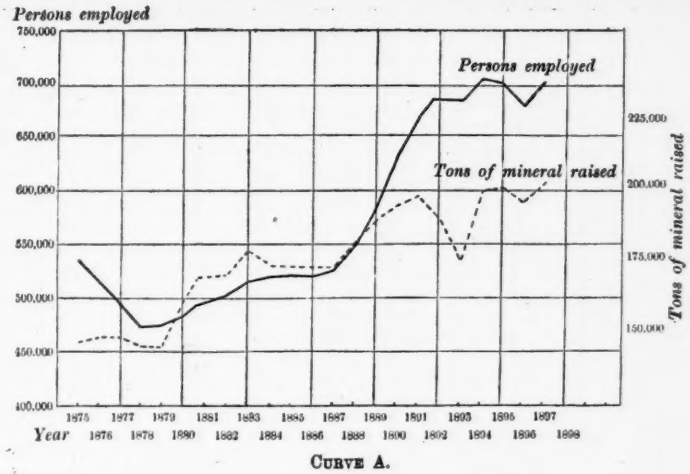
Fig. 2 is an example of a portrait transmitted by this instrument. The sheet of paper on the receiving sheet is covered with carbon copying paper, and this in turn by a protective sheet of transparent paper.

It will be seen that with the exception of certain details the whole arrangement is practically the same as that of the d'Arlincourt Autographic Telegraph above referred to.

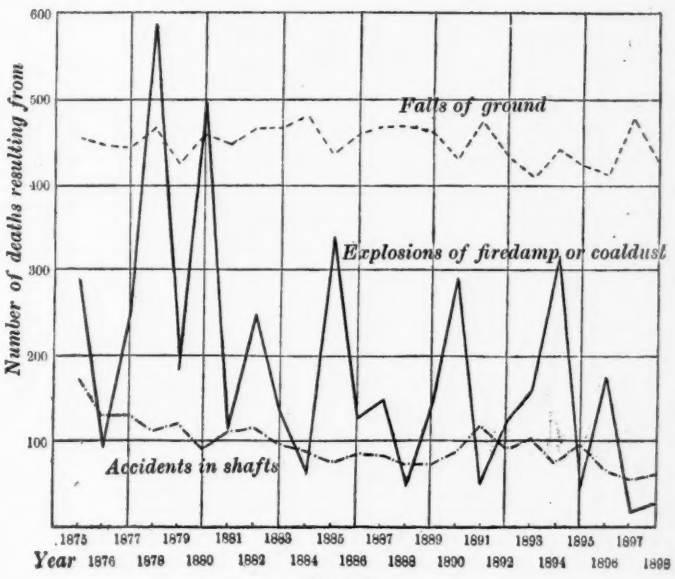
COAL CUTTING MACHINERY FROM THE HUMANITARIAN POINT OF VIEW.

By ERNEST KILBURN SCOTT, A.M.I.C.E.

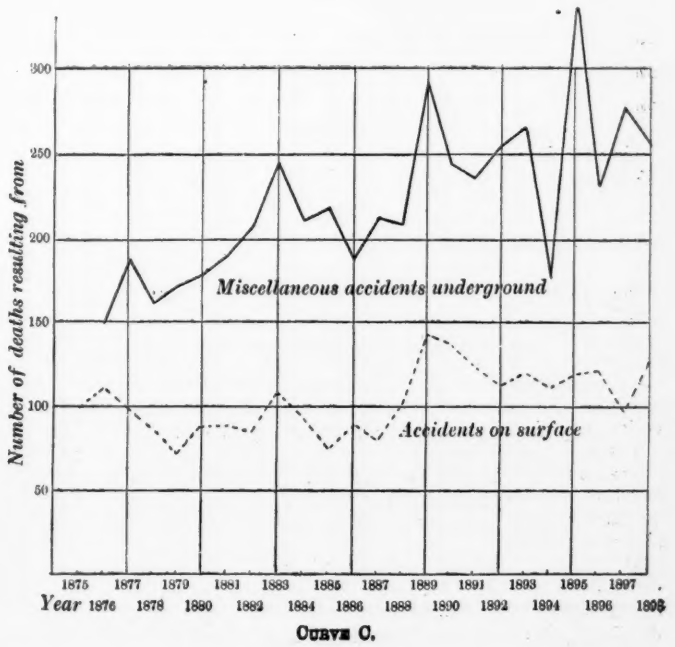
THE four curves accompanying this article are plotted from Government statistics during the last 24 years, and are very instructive. It will be noticed from Curve A that whereas the tons of mineral raised has increased from 145,000 to 200,000, and the number of persons employed from, say, 500,000 to 750,000, the total number of deaths resulting from explosions, falls of ground, shafts, underground and surface workings (see Curve D) shows a distinct tendency to drop. This is especially noticeable between the years 1894 and 1898, years, by the way, in which there has been a good deal of expansion in the application of up-to-date machinery, and especially electrical machinery and appliances to colliery work.



CURVE A.



CURVE B.

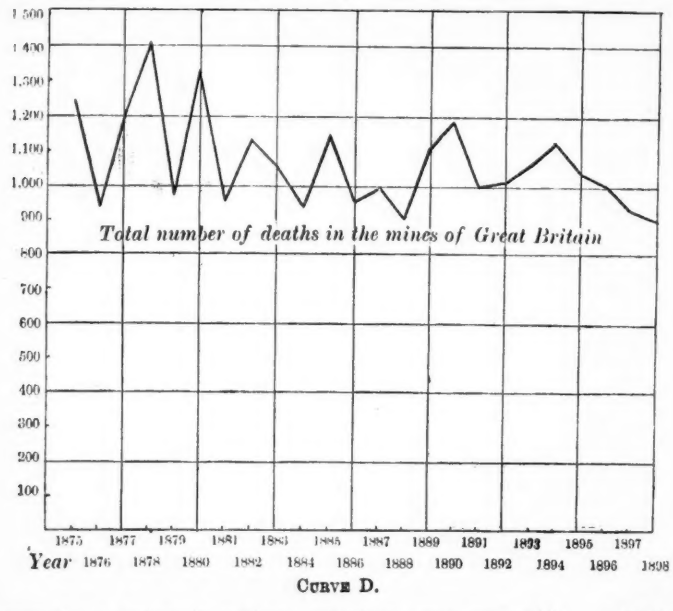


CURVE C.

Curves B and C give an analysis of the causes of death under the various heads, and I would particularly direct the reader's attention to Curve B. It will be seen that the deaths from accidents in shafts have dropped more or less steadily from 170 in 1875 to 60 in 1898, due, undoubtedly, to the improved forms of winding apparatus and the gradual replacement of the ponderous reciprocating ladders, &c. The many ingenious methods of preventing overwinding have also helped materially to reduce the number of shaft accidents.

The curve giving fatalities from explosion of fire-damp and coal dust, jumps up and down in a most extraordinary way, but here, again, the authorities may congratulate themselves upon the fact that the enforcement of stringent regulations and the raising of the standard of the scientific training of colliery officials has resulted in a distinct tendency to lessen the number and extent of these deplorable accidents. When, however, we come to records of deaths due to falls of ground, we find there is practically a constant average of 450 deaths per annum. Falls of ground are divisible into two classes, namely, falls of roof and falls of side. The first of these sub-divisions, falls of roof, is clear and understandable, but the second is not so clear, because it includes the deaths caused by coal falling on the men whilst they are lying underneath at the work of hewing or holing.

The process of undercutting or holing is roughly as follows:—A small channel is cut along the bottom of the seam, and the coal is wedged down to a height of about 15 or 18 inches. The collier again cuts a groove along the bottom and again wedges down the coal to a height of 12 to 14 inches, props or cokermegs being put in as required to hold up the coal. This is repeated several times until the groove is, say, 4½ feet under, and of a sufficient height to admit a man's shoulders for, say, 3½ feet under; in other words, the hewer's body is almost entirely under the coal, and it is whilst in this position that a good many accidents occur; for example, the miner is careless, and kicks a prop away with his foot, or, to save himself trouble, he does not put in a sufficient number, and, staying under just a moment too long, is crushed by the coal falling upon him. The exact number of such accidents can only be approximated by wading in detail through all the cases which are scheduled under falls of side. This should not be so, and it is a great pity that the otherwise excellent returns supplied by the various mines' inspectors should be spoilt in this way.



Curve D.

It appears to be the general impression that explosions are the cause of the greatest loss of life, probably due to the fact that such accidents are fully reported in the newspapers, whilst the steady drain caused by falls of roof and side goes almost unnoticed.

Of the 826 fatalities *underground* in the coal mines of Great Britain during 1897, only 19, or 2·3 per cent., were caused by explosion of fire-damp or coal dust, whereas 475, or 57 per cent., were caused by falls of roof and side.

Having shown how serious is this matter, the question arises: Is there any means by which this loss of life may be minimised? The answer is most decidedly yes, by the introduction of coal cutting machinery. To start with, such machinery does away with the men having to be under the coal at all, and further, by getting over the ground quicker, the men have a better roof to work under; and as the cut is made in a dead straight line the side has not such a tendency to fall irregularly. Another advantage is that the cut can be made further under, and shot firing to bring down the coal dispensed with, which, of course, considerably reduces the risk of explosions.

There is no question of the superiority of machinery over hand labour, carried on as it is in such an unnatural and inefficient position, but the writer thinks that from the humanitarian point of view alone, it is high time that coal cutting machinery was more extensively introduced in this country. In 1897 there were about 1,200 machines at work in the United States, whereas it is very doubtful indeed whether there are as many as 200 at work at the present time in Great Britain.

AN IMPERIAL TELEGRAPH SYSTEM.

Mr. Henniker Heaton's enthusiasm in the cause of cheap telegraphy is well known, and doubtless his determined and ceaseless efforts to advance the cause which he has so much at heart will not prove absolutely barren. No one, we think, could venture to question Mr. Heaton's ability, but still, many of the arguments with which he endeavours to further his pet projects strike one as being hardly those of a man who can have studied the subject about which he is so enthusiastic. A recent article by Mr. Heaton in the *Nineteenth Century*, dealing with the question, contains much of interest, but at the same time, after a careful perusal of the subject matter, one comes to the conclusion that whilst the desirableness of a cheap Imperial telegraph system is strongly urged (a desirableness which no one disputes), yet there is practically nothing but the very weakest arguments to indicate how the desirable consummation is to be brought about. Mr. Heaton, for example, says "Electricity is the cheapest of natural forces. It can be generated in a moment with a shillingsworth of chemicals. It travels 1, 1,000, or 10,000 miles in an instant, and after the prime cost of wire and plant is met the expense of working is insignificant." A more ridiculous statement by one who presumably knows something of telegraphy, can hardly be imagined. Either Mr. Heaton does not know what he is talking about, or he must be deliberately endeavouring to mislead. To argue that because the cost of the current used in signalling is insignificant, therefore telegraphy must be equally cheap, is incredible. Is no interest to be paid on the very heavy capital expenditure? Does a cable or a land line last for ever and cost nothing for repairs?

"There is absolute certainty," continues Mr. Heaton, "that at some early date we shall be able to telegraph to New Zealand or to any other part of the world for a mere trifle." Will Mr. Heaton definitely state how this is all to come about? Is the prime cost of a telegraph wire between England and New Zealand a mere trifle? And can an unlimited number of words per minute be telegraphed over such a wire? And is the maintenance cost of such a line a mere trifle? Can telegraphic operators be obtained who will give their services for nothing? If all these, and other questions vitally bearing on the subject, be answered in the affirmative, then Mr. Heaton's statement may be admitted to be correct.

"It would be possible," again continues Mr. Heaton, "even now for the sums paid in subsidising the mail packet companies to telegraph the whole of our correspondence with the Colonies *gratis*, with a saving of six weeks in the case of Australia."

Statements like these without one word of explanation as to how it is to be done may be accepted by the uninstructed public, but it does not say much for the writer's sense of logic to be satisfied with making bare statements absolutely unsupported by stated facts. It may be perfectly true, as Mr. Heaton states, that 99 out of 100 messages sent to England from the Colonies are commercial telegrams, and 1 per cent. only are social, and that the reason of this is that the charge for the telegrams is prohibitive, and, further, that if the charge were a "mere trifle," social telegrams would largely increase. It does not require a Mr. Heaton to tell us all this; but apparently it is not Mr. Heaton who can definitely and fully explain how a long telegraph line is to be laid for a trifle, worked and maintained for a trifle, and also so arranged that such a high speed of working is attained as the most skilled electricians have so far never approached. Perhaps Mr. Heaton can do this; he has certainly not done so in the article in the *Nineteenth Century*.

THE INSTITUTION OF CIVIL ENGINEERS' CONFERENCE.

June 7th, 1899.

The Conference of the Civil Engineers commenced on Wednesday morning in the theatre of the Institution, when Sir W. H. Preece, K.C.B., delivered his presidential address. Before this, however, Sir Douglas Fox asked the members to join with him in congratulating the president on the honour Her Most Gracious Majesty had conferred upon him, and in reply to the very hearty recognition of the members present, Sir William humorously referred to the extra weight of his new acquisition in the shape of innumerable requests for subscriptions to hospitals, churches, &c. He was pleased that his lifelong labours had been so rewarded, but his greatest pleasure laid in the knowledge that his friends and fellow-members endorsed the distinction conferred upon him by their hearty good wishes. He then proceeded to deliver the following address:—

We have gathered together from all parts of the kingdom to hold our Second Metropolitan Engineering Conference, and we welcome here many who, temporarily at home, pursue their ordinary work in distant parts of the Empire, or in foreign countries. We represent every department of engineering practice, and we are here assembled to discuss questions of great pith and moment affecting the applications of the fundamental principle of energy to further the interests and promote the comfort, health, and happiness of mankind. Engineering does not run in one groove, nor are its votaries Chauvinistic. We endeavour to benefit every race, and we welcome in our midst every nationality. We embrace in our sphere of operations the whole world. We desire to make our home in Great George Street the Mecca of engineering; and in furtherance of this idea, I am bold enough to suggest that, at the next Conference, the Council should take measures to secure the presence of some of our members, delegated specially to represent engineering in our Empire beyond the seas.

This Conference is not international, in the sense of that held at Chicago in 1893, or of that which I understand is contemplated in the year 1901 in Glasgow, in connection with the Exhibition to be held there, but it may well be Imperial. In whatever quarter of the globe we find ourselves, membership of this Institution has become a password; and the invariable support accorded to the Institution by its members in India and the Colonies suggests the desirability of uniting them in a definite and formal manner with our proceedings on such occasions as this.

Conferences facilitate intercommunication among our members, and, by bringing us more into personal and social relations with one another, promote harmony, allay jealousy, and secure progress. Our weekly ordinary meetings are especially convenient for those who live in London; and the audiences are generally restricted to those occupied in the special branch of engineering under discussion at the moment; but these Conferences, in association with our annual conversazione, and by combination with well-arranged excursions and visits to works, tempt many to come to Westminster who are rarely seen there, and facilitate the interchange of ideas between all the departments of our many-sided profession.

They disseminate knowledge by exciting discussion and extracting opinions from those who have acquired them from the only true master—experience—in every quarter of the world. Our weekly meetings receive and discuss papers selected from those submitted for approval, often of the character of probational essays. They open to the young and rising engineer a means of securing the attention and the support of the *patres conscripti* of his profession; but the discussions set in operation in these Conferences are based on short papers prepared for the purpose by those who have been selected as masters of their particular subjects, and invited by the Council to lay the foundation of our talks.

After very mature consideration, the Council came to the conclusion that the objects of our gathering would be best secured by meeting biennially. The reasons that led to this conclusion are financial and administrative. If ever we secure another building—an event by no means improbable, and not perhaps very distant, for the whole of this side of Great George Street has been absorbed by the new design for Government offices—I venture to hope that we shall realise the dream of Sir John Wolfe Barry, and have a hall large enough to hold our annual dinner and to receive the whole of our members and their friends in one evening at our conversazione—a hall that will vie in splendour with those of the ancient guilds of the City of London. No guild and no Merchant Venturers' Society ever compared in numbers and universality of operations with this Institution of ours—the home of an association that embraces every clime and knits together by physical agencies the whole world into one connected whole. Each morning's *Times* is the daily journal of the world; we learn by our work what took place yesterday everywhere.

Now we have to give up our own building to the conversaziones, and to throw ourselves upon the courtesy of our friends and neighbours for accommodation for the meetings of our various sections. The Mechanical Engineers have spontaneously offered us their new home, and there the sections dealing with machinery and electricity will meet. The Surveyors' Institution—before even their own formal occupation of the building—have given us the use of their meeting and council rooms, where the sections dealing with railways, harbours, mines, and metallurgy will assemble. The Middlesex County Council have allotted to us their council chamber and committee room, where those interested in docks, canals, waterworks, sewerage, gasworks and shipbuilding will foregather and discuss.

The programme shows a plethora of important subjects for discussion. The visits to works will, we hope, provide objects of interest and instruction to every visitor. Their popularity is shown by the applications which have been received from over 1,000 members to take part in them, and on the first day nearly 500 claims had to be submitted to ballot—one half of which, I am very glad to say, came from our members in the provinces. We are deeply indebted to those liberal and hospitable persons who have so kindly undertaken to meet our wishes in this essential feature of the Conference.

We found it inconvenient and unpractical to print and circulate the proceedings of the first Conference. We already receive four bulky volumes every year, and old members like myself find it necessary periodically to increase the dimensions of our libraries, and would rather experience a diminution than an increase in the number of our publications. The proceedings of the Conference are equivalent to one-and-a-half times the bulk of our annual ordinary meetings, and comprise three times the number of subjects ordinarily discussed in an Institution session. The proceedings are thrown open to the Press, and we hope that the enterprise of those admirable technical papers that form such a credit to our industries and such a benefit to our profession will, by the completeness of their reports and the rapidity of their issue, render full publication on our part unnecessary.

The growth of engineering is illustrated not alone by the increasing number of affiliated institutions, societies, and members, but by the new fields of application which the advancement of knowledge and the progress of civilisation are opening up. At the present moment, in 10 distinct associations more or less intimately associated with our parent Institution, there are some 22,700 paying members. *Science*, a much abused term, is the systematised collection of the facts and laws of nature, and *engineering* is their practical application to the use and convenience of man. There is a great tendency to put the cart before the horse. Science has followed, it has not led engineering. It is their intimate association which is the foundation of all industrial progress. The war of the microbes, the latest development of biology, is a consequence of sanitary requirements. Our knowledge of the diffusion of molecules and the solution of solids have sprung from the investigation into the mechanical properties and constitution of iron and its alloys, and the disturbances of the Æther are becoming familiar through the practice of the so-called wireless telegraphy. Facts are derived from accident, observation, or practice; laws are the result of research. Engineers have always appreciated science up to the hilt, but they wish that its special votaries were less dogmatic and more modest.

The fathers of our profession, whose names you see emblazoned on our walls—Smeaton, Cort, Watt, Telford, Stephenson—acquired their science by their own researches when professors were largely teaching nonsense and text-books were full of errors. We, however, acknowledged our indebtedness to pure science by giving the place of honour over this chair to Newton; and by adding the name of the most accomplished experimenter of the age, and the most modest but clearest expounder of his own great discoveries—Faraday. I had the great satisfaction last Friday to present an illuminated address to the Vice-Chancellor of the University of Cambridge from this Institution, congratulating our honorary member, Sir George Gabriel Stokes, on attaining the jubilee of his professorship—a pure scientific worthy, ranking with those two great masters who have established and taught the principles that we practise. Of the three men who have been raised by our Sovereign to the peerage for their scientific attainments, we claim two—Kelvin and Armstrong on our roll—while Lister, who belongs to the nation, is also an honorary member of our Institution.

We are proud to enroll also among this class of member another peer, Lord Rayleigh, who, if he had not attained that rank by heredity, would certainly have earned it by his grand scientific work—work so accurate and so reliable that it has secured the faith of the British electrician.

The practice of the engineer as the great civiliser has been well eulogised by our distinguished honorary member, Lord Salisbury. The engineer not only immediately follows the military conqueror, but he sometimes even precedes the civil pioneer. Mr. Cecil Rhodes is opening up Africa by the "wonder-working wire." In a few

months there will be an unbroken line of telegraph from Cape Town to Lake Tanganyika. Peace and goodwill are messages thus distributed without fire, blood, or famine.

Before dismissing you to your different sections, to discuss the various questions allotted to you, I venture to allude to some questions that cannot well be discussed in public, but which may form the subject of conversation among us.

The Lord Chief Justice's Bill for the suppression of illicit commissions is one welcomed by every member of this Institution, and it is most gratifying to find that no suspicion of improper practice has been adduced against our profession. We do, however, hear at times of a dangerous borderground between consultation work and contracting, which is a pitfall to be avoided and to be surrounded by danger signals. Again, occasionally, and fortunately rarely, we find the diploma of the Institution converted into an advertisement; this the Council strenuously protests against in the best interests of the entire body.

The examination system introduced just at the epoch of our first conference, has proved a most unqualified success, and it has been welcomed by none more than by those who are subjected to its troubles. During the last session, 107 candidates passed the Associate Membership examination, in addition to 31 who qualified by passing exempting examinations elsewhere, and 65 who satisfied the conditions of election by theses. Further, 53 passed the Institution examination for Studentship, whilst 167 qualified in that respect by passing various recognised examinations. Thus we added 423 new names to our roll—all of whom satisfied the examination standards. The Council feel that the system of examination has enhanced the intrinsic value of the diploma of the Institution, and that it has added materially to the dignity and responsibility of the profession. This diploma has become so valuable and so necessary to the practising engineer, that occasionally would-be practitioners improperly assume the title of member or associate. Fortunately criticism is too wide-awake, and the public interest too well served by all who are jealous for the prestige of their profession, to permit deceptions of this kind to escape speedy detection.

The position of engineering has rendered it necessary for all new Universities—and especially for the Imperial University of London—to form a faculty of engineering, but the Council of this Institution has deprecated the idea of conferring degrees in engineering. Every engineer must acquire a knowledge of the scientific principles and the mental tools that form the bases and aid the operations of his profession, but he can be an engineer only by becoming an expert in its practice. Examination can test the former qualification alone, and this is what we have introduced. Practical training is not a matter amenable to examination. Hence we consider that degrees in science are quite sufficient to signify the successful completion of a university career, which should be strictly scientific; and that the diploma of the Institution should be the criterion of that professional qualification which is the result of practice alone. And here may I mention that there is a tendency observable to avoid the condition that those admitted into our junior ranks shall be persons who are or have been *bonâ fide* pupils of corporate members of the Institution. Further, no one can be said to be regularly educated as a civil engineer unless he has passed through the ordeal of the training to be acquired in the workshop and the drawing office. It would be well for the comfort of the Council if those who rather lightly, and sometimes thoughtlessly, sign forms for election, would first inquire if the conditions printed on the back of every form were properly complied with.

Let us sincerely hope that this Conference of 1899 will be as successful, as pleasant, and as fruitful as that which took place in May, 1897.

LEGAL.

Headland's Patent Electric Storage Battery Company, Limited, *v.* Lehwess.

This case came before Mr. Justice Ridley in the Queen's Bench Division on Friday last. An action brought by the plaintiff company, whose registered office is at No. 12, Pall Mall, against Dr. Edward E. Lehwess, of 10, Clanricarde Gardens, W., to recover £95 17s. 6d., for the price of goods sold and delivered in July, 1898, viz., 50 H P. type No. 3 traction cells at £1 15s. 6d.—£88 15s.; five oak containing boxes mounted rollers, £5 17s. 6d.; and £1 5s. for fitting cells in five containing boxes and fusing the connections. The defendant by his defence denied that the plaintiffs had sold him, or that he had bought of them the goods in question, but said that he as the agent of the Automobile Association, had agreed with the plaintiffs that they should land free of charge to him (on behalf of the Association) a set of accumulators, which were to be according to specification and were guaranteed to give off 190 amperes, and such accumulators were to be tried for one month on a certain carriage then being constructed for the Association, with a view to the Association purchasing them if on trial they were found to be satisfactory and according to specification. The defendant alleged that the plaintiffs lent the set of accumulators, but they proved to be unsatisfactory and unsuitable for the work for which they were to the knowledge of the plaintiffs supplied, and instead of giving off 190 amperes it only gave off about 105 amperes and the defendant and the Association then offered to return the set to the plaintiffs, who refused to receive the same, alleging that they had been sold to the defendant, and not lent. The defendant also alternatively said that if the contract was a contract of sale, and not a loan, the goods sold by the plaintiff company to him were not of the specification description and quality contracted for, and that the goods supplied were not of the value of £95 17s. 6d., the amount claimed.

Mr. Arthur O'Connor, Q.C., and Mr. Eldridge appeared for the plaintiff company, and Mr. Atherley-Jones, Q.C., and Mr. Stevenson for the defendant.

Mr. O'Connor, in opening the case, said that the plaintiff company were manufacturers and sellers of electric storage or secondary batteries under Mr. Headland's well-known patent. The defendant was a company promoter, and he was introduced to the secretary of the plaintiff company by a Mr. Harrington Moore, who, in the early part of last year was concerned in the French patents of the plaintiff company. On May 18th the defendant called at the office of the plaintiffs and had an interview with the secretary. He was, at that time, full of enthusiasm with regard to the prospects of the patent at the exhibition of motor cars to be held in Paris between June 13th and July 3rd. He expatiated on the splendid opportunity which this exhibition presented for pushing forward the interests of the company by motor traction generally, and he made a proposal to the plaintiff company through the secretary that they should sell to him a carriage or phaeton which they owned for motor purposes, and said he would take it over to Paris, enter it at the exhibition, and drive it about the streets and advertise the battery. When the secretary expressed a doubt as to whether the company were prepared to sell the carriage, the defendant then asked if he could have the loan of the battery, and he desired very much to have a letter from the company with regard to the sale of the carriage or the loan of the battery for the purpose of the exhibition. On May 19th the secretary asked the defendant to call again, and on May 20th the defendant called again and still pressed for the letter. The directors of the plaintiff company declined to sell the carriage, and then the defendant asked the plaintiffs to lend him the battery, so that he might take it over to Paris to put in a carriage of his own, and so advertise it for the purpose of realising at a profit the French patent. On May 21st the plaintiffs wrote to the defendant saying that they would lend the defendant, free of charge, for one month, a set of accumulators for his carriage, and that as soon as they knew the exact size they would have the containing boxes made for the cells. On June 10th the defendant wrote to the plaintiffs asking them to write to the Lamina Company asking them to state what the weight would be, and on June 14th the plaintiff wrote to the Lamina Company giving them the information. On June 16th the defendant wired to the plaintiffs from Paris: "Please deliver 50 large cells as speedily as possible to the Lamina Company." The defendant knew, having been informed by the chief engineer of the plaintiff company, that the larger cells could not be made in less than a month, by which time, of course, the exhibition would be over, whereas a smaller battery could have been delivered at once. It was pretty clear, therefore, said counsel, that the 50 larger cells could have no relation to the Paris exhibition. On June 30th the defendant wired to the plaintiffs asking them to send the set of accumulators to Mullinars, a firm of coach and carriage builders, as quickly as possible. It appeared that Mullinars were building a car for the Lamina Company. The plaintiffs, on receipt of that telegram, at once put the manufacture of the accumulators in hand. They ordered ebonite boxes for the accumulators from an electrical cabinet maker. On July 30th the plaintiffs sent the accumulators to Mullinars at the defendant's request, and they were subsequently invoiced to him. The defendant afterwards called at the plaintiffs' office and intimated that the arrangement about lending the battery for a month should hold good. The secretary thought the matter out, and came to the conclusion that as the exhibition was over it was ridiculous for defendant to expect that the company were going to lend the battery which they had specially made for the defendant according to his telegram. The defendant then said that he wanted the cells for a month, and that it was very hard that he should have to pay the full price. He, however, offered to pay them a reduced price, but asked to be allowed to keep them for a month. He said that if he did not return them at the end of the month he would pay the full price for them. On August 26th the plaintiffs wrote to the defendant, stating that they thought the defendant should buy the cells outright, but offered to take off £20 from their claim if he would send them at once a cheque for £75 17s. 6d. On September 3rd the defendant wrote to the plaintiffs offering to send plaintiffs a cheque for £50 7s. 6d. This the plaintiffs declined to accept, and afterwards the defendant, accompanied by a Mr. Atkins, called upon the secretary of the plaintiff company, who stated that the cells in the containing boxes would not fit into the car. This took place six weeks after the cells had been delivered, and three weeks after the interview in August, when the defendant asked for the month's use of the accumulators. On the next day Mr. Headland went round to Mullinars and found that the carriage builders had placed a strip of wood or iron about the chamber which was to contain the box, and so prevented the accumulator from being fitted in. This was soon remedied, and the battery was fitted in. On September 21st Mr. Atkins called on the plaintiffs on behalf of the defendant, and offered to pay £50 for the cells in addition to the price of the boxes. The plaintiffs declined this offer, but offered to take £70 if the money was paid at once. Mr. Atkins was, however, very persistent, and after some conversation it was agreed that the defendant should have the cells for one month and should then pay the full price for them. In the first week in October, the defendant stated that the cells were not working well, and it was arranged that Mr. Headland should go and see them. He did so, and told the defendant that the cells would be all right if properly charged and kept in working order. The month which was allowed from September 21st expired on October 21st. The cells were not returned, there was no letter of complaint, and there was no suggestion that the cell was other than it ought to be. On October 24th the plaintiffs wrote to the defendant asking for a cheque, and on October 26th the

plaintiffs received a letter from the Automobile Association, Holland Park, W.

Mr. Jones said he would not make any point with regard to that—Dr. Lehwess really entered into the contract on behalf of the Automobile Association, but he would accept all responsibility as there was no doubt he had not disclosed that fact to the plaintiffs.

Mr. O'Connor then went into the correspondence which had passed between the parties, and said that as no settlement was effected the plaintiffs had to commence the present action.

Evidence was then given bearing out the opening of counsel, and that the cells were tested to 180 amperes before they left the plaintiffs' works, and that they could have been got up to 190.

Mr. Atherley-Jones said that the defendant did not desire to shirk any just obligation he might be in, and submitted that the arrangement was that there should be a trial of the cells for a month, such month not being from any fixed date at all. The order to the plaintiffs was for accumulators for a carriage in course of construction. The defendant had the undoubted right to return the accumulators within the month if he was dissatisfied with them. A series of trials with the accumulators had taken place, and it was found that they never gave off more than about 100 amperes, and if that was true it was perfectly obvious that the accumulators would not have fulfilled the absolute essential conditions which Dr. Lehwess had in view. Nor did they fulfil the conditions of the specification.

At the conclusion of the evidence, his Lordship said that upon the documents and the verbal evidence which had been given, he came to the conclusion that the balance of evidence was in favour of the plaintiffs. He thought that the time during which the defendant had the right to reject the machines had been allowed to elapse, and therefore he had to pay for them. His Lordship said that it was not necessary for him to decide the question of whether the accumulators were up to specification, because he had already held that the defendant had lost his right of returning them by not rejecting them within the month, which he had allowed to elapse. But if it had been necessary he should have had great difficulty in finding that the goods were not up to specification. For these reasons he gave judgment for the plaintiffs for the amount of the claim, with costs.

His Lordship granted a stay of execution on the defendant's bringing the money into court within seven days.

CORRESPONDENCE.

Single Line Block Signalling.

Referring to Mr. Hollins's questions upon the above subject, he first asks if "the Board of Trade have sanctioned the use of this arrangement in lieu of train staff or tablet apparatus."

The Board of Trade do not give their sanction to the use of a new and novel appliance.

Taking the train tablet as a case in point, when this was first brought out they did not at once agree to its being used (and one could hardly expect them to sanction an untried appliance), merely permitting it to be used along with the old train staff until it had demonstrated its practical efficiency.

In the same way this is being tried and with an existing train staff, and it has been working long enough to demonstrate its entire reliability.

With regard to his second question. "What is there to prevent the signalman at C (when the rail contact z at B has been operated by a train from A and the signal levers are all back in their normal position) by mistake or otherwise accepting a train from D."

Referring to my paragraph as to this problem. I state that when B pulls No. 4 to accept from A he electrically puts a lock on No. 11 lever at C, thus preventing him from accepting from D.

The point Mr. Hollins is anxious to have made clear is this: When the train from A passes over the treadle z at B, and releases 4, the returning of 4 to the normal *does not* again take lock off 11. It is removed thus, by C accepting the train from B, and pulling *over 8 lever*. No. 8 is pulled to release the plunger to B, and remains locked over until released by the train operating the C rail contact and the mechanical interlocking between 8 and 11 thus prevents 11 being pulled. I hope I have made myself clear on this point.

With regard to the point as to shunting a train at B, I state at the outset that there are no sidings at B or C. They are simply block stations for the relief of heavy traffic. No doubt I could contrive some locking to meet the case of sidings, and prevent C accepting from D during shunting operations at B.

With regard to the whole question of working single-line railways without a staff or tablet, I should like to call Mr. Hollins's attention to the discussion on his own very able paper on "Electric Interlocking," read before the Institution of Electrical Engineers. On page 64 Mr. Spagnoletti says:—

"I think it a great pity that railway officials are so impressed with the idea that the Board of Trade will insist on a 'staff' being used instead of signals being electrically controlled. The staff is a thing that ought to be relegated to the past. It was all very well before the electrical appliances we have now were in use, but it is now a hampering, expensive, and troublesome system, &c., &c."

I think I must agree with him in this. I should be very glad to explain anything further over this matter to Mr. Hollins.

For Mackenzie & Holland,
W. H. Deakin.

Worcester, *June 5th*, 1899.

Electric Piping.

Referring to the criticism which appeared in your last week's issue by Mr. Jenkinson. He enters the field as an unbiassed man, and tries to point out that he does not wish it to be inferred that he blindly approves of any particular system, which obviously shows a weak point, and goes on enumerating the various systems, then dives right away for twin lead-covered wire, which he thinks lends itself to all classes of buildings.

I again say that lead-covered wires are not well suited for houses in the course of construction, neither is it advisable to use them where large alterations are going on.

I am talking about buildings erected in Scotland, not in England, as there is no comparison.

Mr. Jenkinson apparently has lost sight of the fact that four and five different trades are employed on such buildings, hence the necessity for having something impregnable. I do not say that lead-covered wire has no advantages; that is patent to everybody, but it has its disadvantages, which, in my opinion, counterbalance its advantages for this class of work at least. Moreover, this is not the kind of building for which to boom it, and if the lead-covered twin wire is left for Mr. Jenkinson to boom, he will make a very sorry job of it, as his knowledge of house wiring is obviously very limited; when he comes to have 15 years' practical experience of designing schemes for Institution and house wiring, along with a thorough electrical training, he will be better able to discriminate between good, bad, and indifferent systems. Mr. Jenkinson is labouring under a great mistake if he thinks Edinburgh contractors do not know their business as well as our London contractors, as there is no reason why one set of contractors should not be as well versed as the other in pure science along with the practical manipulation of material for use in electrical work, other things being equal; I can only ask Mr. Jenkinson to specify lead-covered wire for any new job to any consulting engineer, and he will find out for himself the fallacy under which he is labouring.

I must mention, before concluding, that Edinburgh contractors do not employ navvies or bricklayers' labourers to fit up electric wires, but workmen skilled in their respective branches along with well-trained electricians, most of them recognised by the City and Guilds of London, not once nor twice, but three or four times, hence our ability to treat work as we do.

J.

June 5th, 1899.

Across the Border.—In connection with the long pending dispute between the St. Pancras and the Islington Vestries as to the laying of mains in Brecknock and York Roads—the border line between the two parishes—the former have informed the latter that they intend to lay the mains in those roads, having regard to all the circumstances of the case, and the expression of opinion by the Board of Trade that the question was one for mutual arrangement between the two parties. The notice given to this effect has alarmed the Islington Vestry, who have referred the matter to the Parliamentary Committee for consideration and report.

E

BUSINESS NOTICES, &c.

Electrical Wares Exported.

WEEK ENDING JUNE 7TH, 1898.

Aden.	Teleg. mat.	Value £600
Alexandria.	Teleph. mat.	305
Amsterdam		210
Auckland		126
Bangkok		405
Bombay		584
"	Teleg. mat.	61
Buenos Ayres		264
Calcutta		333
Cape Town		70
Copenhagen		52
"	Teleg. cable	5,600
Durban		2,609
East London		98
Flushing		10
Genoa		637
Gibraltar		60
Gothenburg		44
Hamburg		42
Launceston		10
Lisbon		793
Lyttleton		245
Mauritius		35
Melbourne		98
Monte Video		157
Ostend		56
Perth		152
Stockholm.	Teleg. wire	1,943
Sydney		85
Wellington		732
Yokohama		23
Total		£15,759

WEEK ENDING JUNE 6TH, 1899.

Adelaide	Value	£60
"	Teleph. mat.	95
Amsterdam		58
Bangkok		183
Bombay		171
Boulogne		62
Buenos Ayres.	Teleg. mat.	150
Calcutta		716
Cape Town		3,505
Colombo		15
Durban		1,915
"	Teleg. mat.	134
East London		75
Fiume		100
Flushing		10
Hamburg		140
Hiogo		340
Hong Kong		1,075
Launceston		35
Madras		13
Malta		22
Melbourne		303
"	Teleg. mat.	1,166
Montreal		70
Ostend		15
Penang.	Teleg. mat.	123
Port Elizabeth		322
Rotterdam		20
Santiago (Chili)		54
Shanghai		122
Singapore		47
"	Teleg. mat.	484
St. Petersburg.	Teleg. mat.	80
Stockholm.	Teleg. mat.	19
Sydney		955
"	Teleg. mat.	193
"	Teleph. mat.	1,805
Tientsin.	Teleg. mat.	1,190
Wellington		215
Yokohama		148
Total		£16,205

Foreign Goods Transhipped.

Lisbon	Value	£2,000
New York		83
Total		£2,083

Hamburg.	Electric light apparatus	Value £50
Total		£50

Annual Picnic.— The employés of the Jandus Arc Lamp and Electric Company, Limited, went to Hastings last Saturday for their annual picnic. Before dinner the party went for a drive through Hastings and the surrounding country. Dinner was followed by the usual toasts and congratulatory speeches on the remarkable increase of business since the last picnic.

Auction Sale.—The sale of the plant, &c., of the Kelvin Electrical Works, mentioned in our last issue, is to take place on Monday, June 19th, instead of June 12th.

Bankruptcy Proceedings. — Under the failure of Edward Lionel Joseph, managing director until last April of Williamson & Joseph, Limited, late of 92, Queen Victoria Street, E C, and Sard's Rents, Bermondsey, the first meeting of creditors was held on the 2nd inst. at the London Bankruptcy Court. The debtor prior to March, 1891, acted as manager to Appleton, Burbey & Williamson, and was then admitted as a partner. Mr. Appleton retired in 1893, and the business was continued under the style of Burbey, Williamson & Joseph for another year. Mr. Burbey then retired, whereupon the trading style was altered to Williamson & Joseph, and so remained until March, 1896, when Williamson & Joseph, Limited, was floated with a capital of £10,000 to take over the business. The debtor acted as vendor, in which capacity he was to receive £5,526 cash and £4,993 in shares. The latter were duly allotted, and he received £1,300 on account of the cash consideration, which was all due to Mr. Williamson and relatives of that gentleman. The debtor acted as managing director of the company until last April, when the debenture holders obtained an order appointing Mr. T. S. Wederall, chartered accountant, Coleman Street, E C, as receiver and manager on their behalf. He has since assisted that gentleman in the management of the business, which was transferred last September to the Northampton Works, Northampton Grove, Canonbury. He attributes his failure principally to his liability through guaranteeing in certain instances the debts of Williamson & Joseph; also to his liability for the purchase money for the interest of Mr. Williamson in that business. Mr. Howell, assistant receiver, reported that he now had a copy of the accounts, which showed unsecured debts, £7,618. There were no assets of defined value, but the debtor had appended a note to the effect that he had an option to purchase the freeholds of the Northampton Works, and that he held 4,293 shares in Williamson & Joseph, Limited, the value of which would only be ascertained on realisation. It was stated by the solicitor to the petitioning creditors that an application was before the Court for a compulsory winding-up order to be made against the company, and that question stood over for a fortnight. After some discussion the meeting was also adjourned for a fortnight.

Notice is given of intended dividend in the case of Fredk. Marson (F. Marson & Co.), electrician and ironmonger, Leicester. The last day of receiving proofs is June 20th. Mr. W. M. Richards is trustee.

We read in the *London Gazette* that the receiving order made on March 25th in *re* David Cook, engineer, 165, Queen Victoria Street, E.C, was rescinded and dismissed on June 5th, all debts having been paid in full.

A meeting of creditors was held on 2nd inst. in the case of H. J. Wimshurst, electrical engineer, at Coventry. The liabilities were placed at £92 and the assets nil. The failure was attributed to loss on experiments on and taking out a patent for a motor car engine, and also to dealings with money lenders.

Liquidation Notices. — A meeting of the Telegraph Manufacturing Company, Limited (old company), is to be held on July 5th at the Britannia Telegraph Works, Helsby, to hear an account of the winding-up from the liquidator, Mr. J. Brotherton.

Messrs. New & Byrd, Limited, electrical and general engineers, Liverpool, are winding up voluntarily. Mr. T. A. Hanmer, 15, Harrington Street, Liverpool, is liquidator.

Creditors of Messrs. G. R. Blot & Co. are to send particulars of debts, claims, &c., to Mr. A. D. Fairbairn, liquidator, 64, Cannon Street, E C, by July 25th.

A general meeting of the West Coast of America Telegraph Company, Limited, will be held at Winchester House, E.C., on July 7th, to hear an account of the winding-up from the liquidator, Mr. F. L. Robinson.

Catalogues, &c.—Officina Elettro-technica Meccanica G. Galatte. This is the catalogue of a Trieste firm who are making generators, motors, and transformers, for both continuous and alternating current. The different machines are given a distinguishing letter and their output, speed, and weight are tabulated together with pulley sizes. Fifty periods per second appears to be the rate for alternating current. The list is well got up and each machine is illustrated.

The North British Rubber Company send a new price list of vulcanised india-rubber for mechanical purposes.

Changes of Address.—Messrs. P. C. Middleton & Co. have removed their head office, showrooms, stores, and works, to more extensive premises, as under:—(Head office and showrooms) 258 and 260, Union Street, Aberdeen; (Stores and works) Union Row, Aberdeen.

Messrs. Lyon & Crosbie, consulting engineers, have removed their offices to more commodious premises at 63, West Regent Street, Glasgow.

The Copper Market in May.—Messrs. H. R. Merton and Co.'s circular for the fortnight ending May 31st shows that the check to consumption which was so noticeable during the first half of May, extended over the remainder of the month, and the total deliveries have only reached 16,074 tons as compared with 20,467 tons for May, 1898. The supplies of copper have, on the other hand, totalled 19,701 tons, and the stocks which, on April 30th, were 26,529 tons, have jumped up to 30,156 tons at the end of May, a gain of 3,627 tons. This stock has not been exceeded since December, 1897, and it is a welcome sign that the Amalgamated Copper Company have not been able to govern supplies to the extent that they hoped. During May only 6,625 tons of copper were shipped to European ports from America, a diminution of 4,000 tons as compared with the corresponding month of 1898. Had no increase of shipments occurred from other countries, the supplies of copper would not have balanced the deliveries and stocks would have fallen. But Chili and other countries outside the ring of chief copper-producing countries, have shipped large quantities of copper during the latter half of the month of May; the shipments from countries not enumerated in Messrs. Merton's circulars having reached a total of 6,223 tons, as against an average of 3,000 tons per month for the 12 months ending May, 1899. If this total of over 6,000 tons should be maintained in succeeding months, these outside countries are evidently going to save the consumer from being squeezed. As the shipments in April from these same countries only reached 1,165 tons, the increase observable in May is possibly merely due to the arrival of shipments that should have arrived in April, and it may not be any proof of increased producing power of the mines. The price variations of copper during May have not shown the downward tendency to the extent one would have expected from a consideration of the figures relative to supplies and deliveries given above. On April 30th the price of G.M.Bs. was £77; on May 15th it was £78 10s., and on May 31st, £76 15s., a net drop of only 5s. for the month. The publication of the statistics which have been analysed above will, however, we think, relieve the buyers from anxiety as to the future movement of prices, and will, we hope, lead to a considerable fall during the first half of the present month. Company promoters have been busy in the world of copper mining finance during May, and the prospectuses of no less than four new companies have appeared during the month. We give condensed details of these below:—

1. The Tablas Finana Copper Company. Capital, £150,000. This company acquires 377 claims, covering 942 acres in the Provinces of Granada and Almeria, Spain, from the Colonia Syndicate, the vendors, who are to receive £20,000 in cash and £40,000 in shares for their rights. Copper mining and smelting were carried on in this district up to 1869, when the supply of timber for fuel was exhausted. Two years ago a railway was completed, which renders these mines again workable. The ore is spathic iron and ferro-cupreous pyrites, and is estimated to contain 10 to 15 per cent. copper. (May 9th.)

2. The Panuco Copper Company, Limited. Capital, £500,000. This company has been formed to purchase and work the Panuco copper mine in Northern Mexico. The nearest railway is 36 miles distant, and transport to this point will cost $7 per ton ore. The copper-bearing strata have been exposed by tunnels, drifts, &c., and between 280,000 and 300,000 tons ore are stated to be in sight. The average value is 6 per cent. copper and 12s. per ton silver and gold. A concentrating and smelting plant is to be erected at Monclova, the railway town. The purchase price has been fixed at £376,000,

£208,000 of which is to be paid in cash. Mr. S. W. Carlton is the vendor, and is re-selling at a profit. (May 27th).

3. The Lloyd Copper Company. Capital, £250,000. This company has been formed to purchase and work the Lloyd copper mine, situated at Burraga, N.S.W., 35 miles from Perth. The mine has been worked continuously for 22 years, and by present methods the cost of copper production is £37 per ton. It is estimated that, by use of improved smelting furnaces, this cost can be reduced to £27 per ton copper. With the new plant which it is intended to erect, the output will reach 9 tons copper per day. The Copper Purchase Syndicate are the vendors, and are re-selling at a profit for £200,000, £116,000 of which is to be paid in cash. (May 29th.)

4. The Copper Company of British Columbia. Capital £100,000. This company has been formed to purchase and develop the Lancaster, Simcol and Toronto Fraction copper mines in the district of East Kootenay, B C. A Mr. P. H. Steevens is the vendor. The writer has not been able to get further details of this flotation.

It must be pointed out that, in nearly every case in which a copper mining company has been floated during the past six months, an individual or syndicate is *re-selling at a profit*, and this fact lends additional emphasis to the warning given in one of our first reports as to the need for much caution on the part of intending investors. Mining companies floated during a period of high prices for the metal produced are seldom capitalised at a fair figure, and copper mining companies are no exception to the rule. In conclusion, we may draw attention to some remarks made by the chairman of the Northern Territories Exploring Company at the annual meeting of shareholders on May 8th. This company owns concessions 510 square miles in extent north of the Zambesi, and Mr. F. R Lewis, during a recent exploring expedition, has discovered in this district large numbers of old copper mines, with remains of the native smelting apparatus. Some of the copper shown by the natives contained silver. The Cape to Cairo Railway, *when made*, will probably deviate, in order to tap this copper-producing district. So important is the discovery considered, that the name of the company is to be changed to the Northern Copper B.S.A. Company. All these facts relative to promotions and discoveries of copper in new districts show the hopelessness of attempting to create a monopoly in such a widely distributed metal, and sooner or later the developments now occurring must have their natural effect in causing a return of the price of copper to its normal level of £50 per ton.

Electric Exploitation Company, Limited.—Under a winding-up order recently made against this company, the statutory meeting of the creditors and shareholders was held on Wednesday at the Carey Street Offices of the Board of Trade. Mr. G. S. Barnes, senior official receiver, reported that the company was formed in January, 1894, with a nominal capital of £25,000, to acquire and deal in certain inventions relating to the storage of electricity, and particularly the rights in inventions belonging to Mr. Max Sussmann for an electric lamp specially adapted for use in mines. The promoter of the company was Mr. V. C. Doubleday, who with 12 other gentlemen financed Mr. Sussmann during 1893, and between them expended £2,400 prior to the formation of the company. When the company was registered, Mr. Doubleday and Mr. J. A. Buchanan became directors in spite of the fact that they were interested in the sale. A prospectus was privately issued in February, 1894, and shares to the value of £367 were subscribed, which sum represented the working capital of the company at its inception. It was not specifically stated in the prospectus that two of the directors were interested in the sale, and it might be that the gentlemen named had rendered themselves civilly liable to repay money to the company, in consequence of that fact not being disclosed. Under the purchase agreement 20,000 shares were issued to the vendor, and 12,500 of the number were divided between the gentlemen who had provided the money for the patents. The remaining 7,500 were issued to Mr. Sussmann, but were subsequently transferred to some of the same persons. Two sums of £500 and £250 respectively were borrowed from Mr. Buchanan on the security of debentures. During 1895 negotiations were entered into with Mr. Harry Saymour Foster for the promotion of the Sussmann Electric Miner's Lamp Company, Limited, to acquire the whole of the Exploitation Company's inventions and patent rights. Mr. Foster was to receive £20,000 in cash and shares out of the £45,000 which it was intended that the Sussmann Company should pay for the inventions. The last-named company was registered on May 6th, 1896, and two days later an agreement was entered into for the sale of the patents for £45,000, the purchasers agreeing to allot deferred shares to the company and to give them one-third of all moneys, royalties, or other consideration received from the sale of the foreign patents. It was stated that the issue of the Sussmann Company's prospectus resulted in applications for 19,000 shares including 11,580 shares for which Mr. Foster obtained underwriting contracts. Having regard to an arrangement which existed between the two companies, the Sussmann Company was to retain £12,500 for working capital which left only £7,500 for the payment in cash under the purchase contract. Mr. Foster was paid £6,340 in cash and shares for £13,660, but the vendor company received only £650 in cash and £24,350 in shares. The secretary ascribed the failure of the company to the limited subscription for shares in the Sussmann Company which resulted in a very small sum being received in cash upon the sale of the property. The unsecured debts were returned at £433 and there were claims to the amount of £720 on debentures, whilst the assets consisted of shares in the Sussmann Company to the value of £1,102. In the absence of a quorum the meeting of creditors was formally adjourned for a week. The shareholders deputed the Official Receiver to act as the liquidator and wind up the company in the usual manner.

Life Buoy with Electric Signal Lamp.—The greater part of loss of life in connection with shipwrecks at night is due to the inability of the victims to get hold of an object which will keep them afloat until the lifeboats can reach the place of the disaster. Captain Meller's electric life buoy is considered to supply an excellent means to cope with this difficulty. The buoy consists of a large cork ring which is covered with stout sail cloth, and of an electric lantern which is mounted on a tubular pole. The incandescent lamps in the lantern receive their energy from an electric accumulator placed in a strong metal case at the foot of the lamp pole. This lantern is placed almost in the centre of the cork ring and connected to it by means of a universal joint which enables the lantern to remain in an upright position while the ring is pitched into all possible positions by the waves. The reason for not placing the lantern exactly in the centre of the cork ring is to create a tendency of the latter to fold into a plane with the crossbar and to fix readily to the side of vessels. The pole of the lantern passes through a crossbar which is connected with the switch of the lantern. A spiral spring is inserted between this crossbar and the lantern head and tends to put the switch "on." It is, however, prevented from doing so as long as the whole apparatus is suspended by its crossbar, as the weight of the former suffices to compress the spiral springs. But the lights may be tested while the apparatus rests on its support, and, as soon as it leaves it and gets immersed in the water, the spring acts and the light is switched on. The cork ring is large enough to accommodate one or two people inside, and a number of rope loops are provided for others to cling to it. The accumulator is of Zerning's metalloid type, with which shifting or crumbling of the plates is said to be impossible as the interstices are solidly filled up with a substance that retains the electrolyte and prevents spilling under the most severe conditions the battery can be put to. On the other hand, the electrolyte is readily given off to the plates for the purposes of the electro-chemical action while the light is switched on. The conditions which this battery has to fulfil differ materially from those under which accumulators have usually to work, as this accumulator has only to serve for a very few discharges, but it must be able to retain its charges for a very long period. Zerning's accumulator is claimed to fulfil these conditions to a very high degree. The top of the gun-metal vessel in which it is rigidly placed has a screwed-on cover for inspection and for replenishing the electro

lyte. The stem of the lantern is made of a solid drawn steel tube which offers ample protection for the leads which connect the accumulator with the lamp. These leads pass first through stuffing boxes in the cover of the accumulator before they enter the tube, the lower part of which is filled up with a suitable non-conducting material as an additional precaution. The lantern proper consists of a stout spherical glass vessel similar to those used for nautical purposes, and fitted on top and bottom with water-tight gun-metal covers. Below the top cover an ebonite plate is provided which carries the terminals of the leads from the accumulator, and also two incandescent lamps with their terminals. On the bottom cover is mounted an electro-magnetic switch which throws the second lamp into circuit when the first gets unserviceable by any cause whatever. We are informed that extensive trials have been made with this electric safety buoy by independent experts, who report very favourably about it; and amongst those who have taken it up are the German Imperial Navy who have bought a number for further trials. The Anchor Electric Company, of 39, Victoria Street, Westminster, have taken up the manufacture, and propose to give exhibitions of its efficiency.

London and Provincial Electrical Company, Limited.—In the Companies Winding-up Court on Monday, before Mr. Justice Wright, counsel appeared in support of a summons taken out by Mr. Hullins, receiver and manager on behalf of the debenture holders of the London and Birmingham Brass Founders' Company, Limited, who asked that the liquidator of the Electrical Company

might admit him as a creditor of the company for £146 5s. 6d. It was a claim for goods sold and manufactured by a brass founders' company in the ordinary course of their business, and it seemed that the defence was that the agent who ordered the goods, which consisted of 50 gross of screws and pins, had no authority to order more than £2 worth at a time. Counsel, however, submitted that on the printed order forms supplied there was no intimation of this, and that the printed words "No goods will be paid for unless accompanied by this order" were sufficient to render the company liable. Mr. Hamilton, for the defendant company, said that £9 7s. had been paid into Court, and he produced an affidavit from the agent who gave the order stating that he was only a foreman. His Lordship, after some arguments, said he was not satisfied with the affidavit as to authority, but he found for the applicants for £55 11s. 5d., with costs.

Montauk Fire Detective Cable.—In the ELECTRICAL REVIEW for January 14th, 1898, page 60, we gave an illustrated description of what was then known as the Montauk *multiphase* fire cable, but the new title at the head of this note is free from any confusion of terms which "multiphase" might convey to the mind of the English reader. Mr. James F. Butterworth, of 28, Queen Street, E.C., is introducing the cable to the English market. The construction of the cable and the details of the wiring were described on the date mentioned, but we may briefly state that when a fire occurs in the neighbourhood of the wire, the heat fuses and expands the inner fusible coating and forces it out through the insulation into contact with the overlying return wire, thus forming a metallic contact between the inner and outer wire, closing the circuit, and turning on an alarm. When the circuit is automatically closed, the current energises magnets in a controller, which then act upon a system of small levers, and release a clock mechanism, so giving the signal by means of rotating discs which, by make and break contacts, ring the bell and indicate the locality of the fire. The cable is of excellent use also for burglar alarm purposes, as, if an attempt be made to cut the wires, the pliers form a metallic connection between the inner and outer wires of the cable and close the circuit. It may be mentioned that it takes actual flame or 360° Fahr. without flame to cause the wire to send an alarm, thus preventing false alarms from an overheating of a building which might not always be dangerous. Every fractional part of the wire is, of course, an alarm-giving point, and for warehouses it would be a sure protection to have the wires placed up above goods on winding reels in such a manner that they can be easily removed in the morning and placed in position again at night. By means of the necessary connections it could be arranged for any building equipped with the cable to be connected with the telephone exchange so that, if desirable, the operator there would be informed of what was occurring and could immediately acquaint the Police or Fire Brigade thereanent. We are given to understand that the U.S. Navy are trying it in their coal bunkers with a fusing point of 220° (obtained by cadmium) in order that the alarm may be given in the captain's room if fire is developing in the coal bunkers or hold. The Superintendent of the Boston Fire Department has expressed the opinion that the cable is superior to the isolated thermostats used in the present automatic systems. Another point in its favour is the decision of the executive committee of an American underwriter's association last year to make an allowance for a fire alarm box system, with watchman, of 7½ cents. off the usual rates, but where the Montauk cable is used without watchmen, to allow 10 per cent. The reason for this is that the cable, unlike the watchman, neither slumbers nor sleeps. We believe that Mr. Butterworth has a model of this very ingenious system open to inspection at the address mentioned above.

New Oil Filter.—Messrs. Shelby & Co., of Finsbury Circus Buildings, E.C., are introducing a new oil filter, shown among our advertisements. Its method of operation is as follows:—The filter is filled with pure warm water to the level of the lower gauge cock. The waste oil is poured in at the top and first passes through a pan of cotton waste which collects most of the impurities. It then passes into the chamber and down the perforated pipe, where it meets the water. The weight of oil in the chamber above, however, carries it down to the perforated filter plate, where it spreads under pressure in a very thin film, becoming thoroughly mixed with the water. The oil then rises through the perforations to the surface of the water, by which time it is quite pure and can be drawn off for use. The dirt settles at the bottom and can be drawn off at the lower cock without interfering with the continuous action of the filter. A steam coil is provided underneath the false bottom; but if the filter is kept in a warm place, *e.g.*, near the boilers, steam connection is unnecessary. The temperature which has usually been found to give the best results is from 115° to 120° F. A point claimed in favour of this filter is its simplicity of construction, there being nothing to break or get out of order.

Partnership Notice.—Mr. F. F. Bennett, consulting engineer, of Manchester, has taken Mr. Aubrey W. Thomas (late engineer to the Keswick central station) into partnership, and will in future practice under the title of Bennett & Ward Thomas.

Pritchard v. Bromley (Kent) Electric Light and Power Company.—In the Queen's Bench Division of the High Court, before Mr. Justice Ridley, sitting without a jury on May 31st, the case of Pritchard *v.* The Bromley (Kent) Electric Light and Power Company was heard. Mr. C. E. Jenkins, Q.C., and Mr. Elverton, and Mr. Jenkins appeared for the plaintiff, and Mr. Jelf, Q.C., and Mr. Hume Williams, Q.C., for the defendant company. This was an action brought by Mr. Alfred William Pritchard to restrain the defendants from committing an alleged building trespass and he also claimed damages. In 1892 the plaintiff became the owner in fee of certain land and premises in West Street, Bromley, and it was said that the defendants proposed to establish in the centre of Bromley and immediately contiguous to the plaintiff's premises extensive works for the generation of electric power and light for the purpose of supplying current to Bromley and Chiselhurst and district. The plaintiff alleged that the defendants had committed trespass on his premises by the erection of a high wooden hoarding along the entire length of the plaintiff's building on the South Side and situated only a few inches distant, which besides being on plaintiff's land entirely covered up two windows on the south side of the premises. He also complained of the erection of a chimney stack, 120 feet high, which was only 27 feet away from his premises. The defendants denied that the plaintiff had acquired the prescriptive rights to light in respect of the south windows, and generally denied the plaintiff's allegations. They also said that what they did was by virtue of the lease and licence of the plaintiff verbally given by him to Mr. Gra'z, the builder, who was executing the work early in May, 1898. The defendants also denied that either the chimney stack or their works generally caused a nuisance.

His Lordship in the result came to the conclusion that the plaintiff had failed to make out his case with regard to the hoarding on the south side of his premises. He, however, held that defendants had committed a trespass by putting concrete on his land, and on this head awarded him ¼d. damages. With regard to the obstruction of light and air on the western side the plaintiff was awarded £35 damages, and the general costs of the action. The defendants, however, were awarded the costs of the issue the plaintiff had raised and failed to prove.

Rustschuk Industrial Exhibition, 1899.—Mr. Arthur Gobiet, organising commissioner, appointed by the Bulgarian Government for the international section of the above exhibition, sends us a communication explaining to some extent the arrangements for his section. It comprises all machines, motors, apparatus, tools and implements of every industry and handicraft, and agriculture. The exhibition will be opened on August 14th next, and numerous visitors are expected from Roumania and Servia. Diplomas and prizes will be awarded. For particulars address Mr. Gobiet at Prague Karolinenthal, Bohemia.

Search Lights.—A re-arrangement of the electric search lights at Milford Haven has recently been carried out. More powerful lights have been introduced with a view to commanding the entire Haven.

Single-Phase Alternating Current Motors.—The General Electric Company, Limited, inform us that the Maschinenfabrik Oerlikon, whom they represent over here, have made some important improvements in their well-known single-phase alternating current motors, and they can now build machines from $\frac{1}{20}$ H.P. to 4 H.P., with a starting torque equal to ½th of that at full load, the starting current not exceeding the normal full load current by more than 50 per cent. These motors are without collector rings, and are provided with a starting device consisting of a starting box and switch with an induction coil and resistance. They also build motors with collector rings from 2 H.P. to 100 H.P., and these have a starting torque equal to ⅓rd that of full load, without drawing more than their normal full load current. For these an additional starting resistance in the rotor circuit is necessary. With these improvements the motors are now provided with a pulley of double width—a fast and loose pulley on the motor itself can be dispensed with in most instances, and will only be fitted when specially required. From 18 H.P. upwards these motors can also be made for high tension. We are informed that the efficiencies obtained are high, as the following instances will show:—

Horse power	3	9	30	70
Half load	76 %	81 %	83 %	89 %
Full „	80 %	85 %	87 %	95 %

At the factory a large stock will be kept of machines partly finished and partly ready for winding. The General Electric Company are now arranging to keep in London a stock of the sizes most in demand for speedy execution of orders.

Trade Announcement.—Messrs. Dobson & Curtis Bros., of Dublin, Cork, &c., have appointed Mr. P. Jones, High Street, Bangor, their agent for that town.

ELECTRIC LIGHTING NOTES.

Aberdeen.—The Watching and Lighting and Tramway Committees have conjointly been considering the lighting arrangements in George Street, and what alterations will be necessary in view of the erection of an overhead trolley tramway. After discussion, it was agreed to light the street from the side, instead of overhead as at present, by means of brackets projecting from the houses.

The Committee recommends that the price of current for motive power for the six months from July 1st, 1899, should be fixed at 3d. for the first hour daily of the maximum demand, thereafter 1d. per unit.

Altrincham.—The Altrincham Electric Supply Co., Ltd., during the four years of its existence, has made considerable progress. Notwithstanding initial difficulties, a substantial profit has been made, which has been appropriated to the sinking fund, and to a reduction of the meter and transformer charges. Nearly 30 miles of mains have been laid, and there are attached to the same upwards of 400 consumers, representing 24,230 8-C.P. lamps.

Asylum Lighting.—The construction of the new buildings at the City's asylum at Stone is proceeding as rapidly as labour disputes will permit. Messrs Mavor & Coulson have obtained the contract for the lighting of the institution by electricity. Messrs. Tinkers will supply the boiler work.

Blackburn.—At last week's Town Council meeting the Electricity and Tramways Committee recommended that the consulting and electrical engineers be instructed to prepare detailed plans and estimates of extensions to the electricity works, and that application be made for the necessary borrowing powers. They also recommended the preparation of plans, &c., for the conversion of the Darwen, Accrington, and cemetery sections of the steam tramways to the electric system.

Blackpool.—At Monday's Council meeting the Electric Tramway Committee recommended the reduction in the charges for electricity from 8d. to 7d. Mr. Brodie, the chairman of the Committee, said the reduction would mean a decrease in the revenue of £1,000 a year. The working expenses had been reduced 30 per cent. during the year, and in time the engineer hoped to charge as they did at Brighton. The overhead trams would be working this week, and the doubling of the Promenade lines would be completed in a month. The minutes were approved.

Bolton.—The Town Council on Wednesday adopted the recommendation of the Electricity Committee that £100,000 be borrowed for extensions in connection with the electricity department. Dr. Panton said the committee had come to the conclusion that it was absolutely necessary they should have further borrowing powers in view of the extension which would be required before long. The engineer's original estimate showed that £93,000 was required. They had now borrowing powers for £68,222, and were overspent by £2,387. The committee meant to do a great deal with the £100,000. They wanted new engines and engine beds, a new chimney, a condensing plant, extra generating machinery, a travelling crane, five new boilers, pumps, economisers, mechanical stokers, coal conveyers, dynamos, switchboards, accumulators, &c. In addition they had to provide additional mains for the extended borough. Application is to be made to the Local Government Board *re* loan.

Bonchurch (I.O.W.)—The Ventnor Electric Light and Power Company says that it can light the village with electricity by August 1st if the order is given at once. The Parish Council has accepted the offer, and is asking the Isle of Wight Rural District Council for permission.

Bournemouth.—The Electric Lighting Committee has been asked to consider the surveyor's proposals with regard to using power from the refuse destructor for electric lighting purposes.

Brazil.—A company has just been formed in Brussels, with a capital of £50,000, to be known as La Compagnie d'Entreprises Electriques de Para (Brazil).

Bury.—Mr. S. J. Watson has recently prepared two reports for the Electric Lighting Committee on the charges made to consumers for electric supply. The Committee has decided not to alter the charges for lighting current, but those for motive power current will be altered from 2½d. per unit to 3d. for the first hour's average use per day and 1d. afterwards, and certain reductions are to be made in meter rents. Mr. Watson hinted that it might be worth taking up a hiring-out system for motors at a later date.

Canterbury.—Current was on 1st inst. switched on at the Foresters' Hall. The installation, which has been carried out by Mr. E. J. Philpot, consists of:—Large hall, three coronas with 25 frosted lamps, 8-C.P., two each with 15 lamps with shades, 16-C.P.; platform, two, with shades, 16-C.P.; billiard room, eight 16-C.P.; reading room, four 16-C.P.; dressing room, lavatory, and corridor, 18 16-C.P. All lamps are controlled from a distribution board fitted in the main corridor.

Cardiff.—The Electrical Committee are concerning themselves too much about a matter which is rightly within the province of the electrical engineer-in-chief. One of the electricians at the station resigned on account of ill-health, and Mr. Applebee recommended the appointment of a certain man to take his place. But a member of the committee seemed anxious that the best fitter in the works should be promoted to the post of assistant electrician, and in spite of Mr. Applebee's remonstrances that there was no fitter qualified to take charge several speakers pressed the matter. In the end a compromise was effected, and it was agreed that the most experienced fitter be put on the work for a month on trial under one of the electricians.

To lay mains up Castle Road, Albany Road, and Wellfield Road is estimated by the engineer to cost £2,476, and the promises to take supply are sufficient to more than cover all expenses. The Electric Light Committee has resolved to carry out the work, and the money will be raised at once.

Chelmsford.—The committee which has been considering the question of purchasing the undertaking of the Electric Light Company, has further discussed Mr. Hammond's report with him personally, and it is expected that by the end of the month a special council meeting will be held to consider the matter. The company is being requested to abate the smoke nuisance at the works.

Coventry.—The Coventry City Council on Tuesday received the annual report of the Electric Light Committee; the period covered, however, was 15 months, in order to bring it in line with other departmental reports. The number of consumers had increased from 100 to 135, and the lamps connected from 8,149 (8-C.P.) to 10,699. Further connections were being made. The number of units sold had increased from 79,583 to 149,547, and the revenue from sale of current and meter rental from £1,958 19s. 8d. to £3,597 2s. 9d. The profit on working was £333 8s. 5½d., against £106 2s. 8½d. The profit would have been substantially greater had not the expenses been swollen by an exceptional item of £333 1s 10d. for repairs and maintenance of mains, as compared with £80 13s. 6d. last year. The mains were now in a satisfactory condition, and the item for maintenance might be expected to be in future of normal dimensions. The charge for interest on capital was £1,075 12s. 5d.; temporary loans, £77 13s. 4d.; payment to stock redemption fund, £78? 17s. 8d.; and composition for stamp duty, £26 14s. 4d., together amounting to £1,962 17s. 6d. Deducting the working profit of £333 8s. 5½d., the net charge on the rates was £1,629 9s. 3½d., as against £1,558 7s. 11½d. last year. Alderman Hill moved the adoption of the report, which he described as of a progressive nature. Upon the completion of the mains the department would be able to supply a greater number of customers, and a new scale of charges had been introduced with a view to giving an abatement after a certain amount of current had been used. The financial policy of the committee was severely criticised by Alderman Andrews (chairman of the Gas Committee), and during the subsequent discussion the drawing of comparisons between the gas and electric light undertakings was strongly condemned by several members. The report was adopted.

Darlington.—The Local Government Board will shortly hold an inquiry into the application of the Council for sanction to borrow £30,000 for purposes of electric lighting.

Dartford.—The Urban District Council have appointed Mr. W. C. C. Hawtayne as consulting engineer.

Dawlish.—A committee of the Council is considering a letter from Messrs. Taylor & Field with a proposal for a company to take up the electric lighting of the town.

Derby.—Tenders for building the superstructure of the engine house and boiler house at the electricity works extensions have been invited, and that of Mr. Hy. Vernon (£5,369) accepted.

Dover.—The Electric Light Company has informed the Town Council that the board is by no means anxious to part with its undertaking, and could not ask the shareholders to consider any scheme, unless on the most advantageous terms. They therefore declined to propose terms, but suggested that if the Corporation would propose terms which the directors could recommend, they would give them careful consideration. At the Council meeting no observations were made, and the matter was allowed to drop.

Dundee.—The accounts of the electricity department for the past year show a balance of £1,945 16s. 9d. The Gas and Finance Committees last week fixed the charges for electricity as follows:—For any amount of energy up to 20 units, 6s. 8d.; for each unit above 20 units, 4d.; consumers of above 10,000 units to be supplied at 3d. per unit above 10,000, subject in all cases to a discount of 5 per cent. if account paid within 28 days. The public electric lamps are to be charged at the rate of £16 10s. each, being £3 10s. less than last year, and energy for motive power is to be supplied at 2d. per unit instead of 2½d. last year. The expenditure of the electricity department was estimated at £7,039 6s. 7d., but it actually amounted to £6,877 18s., being £161 8s. 7d. below the estimate. The income was calculated at £7,553 17s. 8d., and amounted to £8,823 14s. 9d., an increase of £1,269 17s. 1d., and an excess over actual expenditure of £1,945 16s. 9d. For the current year the revenue, including this balance of £1,945 16s. 9d., is put down at £10,675 16s. 9d., and the expenditure at £10,065 12s. 6d., bringing out an estimated surplus of £610 4s. 3d.

Ealing.—Last week a Local Government Board inquiry was held into the application of the District Council for permission to borrow £44,822 for electric lighting purposes. Loans amounting to £44,822 have been already sanctioned. The clerk stated that all the money had been spent except £24,000. As a business concern they were, under their provisional order, bound to supply people who wanted current. The works were opened in 1894; they were arranged on the assumption that 5,000 private lights would probably be required within three years. But in the result, that estimate of the demand was trebled within three years, and now, in less than five years, they had 24,000 lights actually connected; 600 more are waiting to be connected. Applications are coming in every day. The financial result is, that at the present moment they are practically paying their way. There is a large capital outlay at present, and they could hardly hope to realise actual profits. But last year the revenue was equal to all the expenditure, including the sinking fund. Mr. Jones and Mr. Knight then explained to the inspector the works for which the new loans were required.

Eccles.—At a meeting of the Town Council on Monday, the town clerk was instructed to apply to the Local Government Board for sanction to a loan of £1,793 6s. to complete the furnishing and electric lighting of the new Town Hall premises. A brief discussion ensued as to the extension of the supply of electricity to the whole of the town, in the course of which Mr. Alderman Kendall said the Committee hoped very shortly to come before the Council to ask for permission to extend the plant, so as to cover the whole of the borough, as it was felt that such an extension would be advantageous.

Erdington.—A member of the Council has brought up the electric lighting question with a view to engaging expert advice thereupon, and also applying for a provisional order. The matter was to be discussed on Wednesday.

Essex.—An important electrical scheme is projected for an estate in Essex. It includes about 200 I.H.P., distributed electrically, a trolley line, and electric lighting. Messrs. Taylor and Field, consulting engineers, are reporting upon the matter.

Glasgow.—The sub-committee on the electric lighting of the streets has agreed that, looking to the more important streets which require improved lighting, the electric lighting of Crown Street should not be proceeded with in the meantime. Mr. Hamilton, the inspector of lighting, has been instructed to prepare estimates of the relative cost of lighting by electricity Sauchiehall Street to Overnewton, Argyll Street and Dumbarton Road to the bridge across the Kelvin at Partick, Bridge Street to Queen's Park, and Paisley Road to the toll.

Grimsby.—The Local Government Board having sanctioned the Council's proposed loan of £43,500 to carry out an electric lighting scheme in the borough, the Corporation Public Lighting Committee has recommended the acceptance of the tender of Messrs. Hewins & Goodbind for the erection of buildings and chimney shaft at a cost of £11,525 2s.

Islington.—The Vestry at the meeting on Friday adopted a report of the Electric Lighting Committee in reference to the proposed addition of condensing plant at the electric light station. Mr. A. Gay, the chief electrical engineer, estimated that complete plant capable of condensing 20,000 lbs. of steam per hour could be installed for £4,000, and it was decided to carry out the scheme and to raise the money by loan. It was estimated by the engineer that the economy likely to result from the plant would amount to about £800 per annum. In a further report the Committee stated that they had considered the question of sinking artesian wells so as to effect a saving over the present expenditure for water supplied to the boilers by the New River Company at 8d. per 1,000 gallons. The engineer recommended that two tubular wells should be sunk to a depth of 500 feet each, and that two pumps and engine should be provided at a cost of £2,750. Mr. Gordon, chairman of the Committee, in moving the adoption of the scheme, stated that it was estimated the water would be raised at a cost of 1½d. per 1,000 gallons, thus showing a very considerable saving over the present expenditure. After a long discussion, an amendment moved by Mr. B. James was adopted by 44 to 37 votes deferring the consideration of the question for six months.

The Guardians last week opened tenders for the electric light installation at Highgate Hill Infirmary. There were 22 in all, ranging from £10,117 to £6,880. The estimate of Mr. Enright (the electrician) was £5,900. The tenders have been referred to the Building Committee for report.

Italy.—A scheme has been prepared with reference to the utilisation of the water power of the Caluso Canal in the Canavese district of Redmont. It is estimated that 400 H.P. would be available for the generation of electrical energy for lighting and traction purposes in the district.

Keighley.—The Gasworks Committee recently asked the Corporation for power to appoint an electrical engineer at £300 per annum. The applicants for the post have been reduced, and an appointment is to be made shortly.

Kendal.—A sub-committee, after visiting various towns to inspect electric lighting installations, has reported to the Council recommending the adoption for Kendal of the low pressure direct current three-wire system, as advised by Messrs. Handcock & Dykes. With reference to the proposed water-power scheme, as the water available in connection with the Fisher Tarn reservoir will not be sufficient to adequately meet the probable demand, a central steam driven plant is proposed at the commencement, with the suggestion that the Fisher Tarn proposal be reserved for future extensions. It is recommended that the electricity undertaking be worked conjointly with and upon the site of the gasworks. A plant for 2,500 8-C.P. lamps, with provision in the engine and battery rooms for increasing to 5,000 8-C.P. lamps, is estimated to cost £10,000, with a yearly expenditure, including interest and sinking fund, of £1,030, and a total income of £1,088. The sub-committee advised that steps be taken to ascertain the probable number of lamps required, and afterwards, if desirable, to call in expert advice as to details. In moving the adoption of the report at last week's Council meeting, Alderman Monkhouse said that the reports of Messrs. Handcock and Dykes did not differ very much from that of the sub-committee, except that they were on larger lines. The adoption of the report was carried.

Liverpool.—In a recent report on the practice of the Electric Power and Lighting Committee in regard to service lines, meters, and free wiring as compared with that of other local authorities, Mr. A. B. Holmes, city electrical engineer, says that he does not think it desirable to at present reduce the charges for service lines and meters below actual cost with a view to increasing the demand for current, as there is difficulty in meeting the demand. Possibly at a future date some such step may be advisable for increasing the business of the electricity department.

Llanelly.—The Council is in danger of having its provisional order revoked, as the time allowed has expired. As a firm of London solicitors is anxious to get hold of the order, a special Council meeting will be held to consider the situation.

Londonderry.—The Corporation are considering the question of establishing a private electric lighting system in the city.

Lancaster.—A successful year has been experienced in the Corporation electric light department. The net profit on the year, after putting aside £200 to the reserve fund, is £1,191 3s. 1d. The income from the sale of current increased from £2,383 19s. 1d. to £3,477 9s. 1d., an increase equal to 45 per cent. The profit goes to the relief of the rates. The amount of capital expended is £28,662 13s. 5d., and borrowing powers have been obtained for £35,000. Tenders have just been let for stores and workshops. The financial details of the department for the year show that it is now not only thoroughly established as a rate-paying department but has cleared off the losses of the first two years, as will be seen by the following :—

	£ s. d.	£ s. d.
Profit 1896-7	87 19 8	
„ 1897-8	598 7 2	
„ 1898-9	1,191 3 7	
		1,877 10 5
Loss 1894-5	373 11 7	
„ 1895-6	539 8 11	
		913 0 6
Net profit since established		964 9

The comparative figures will show the progress :—

	1896-7.	1897-8.	1898-9.
Income—			
Sale of current, less discount ..	£1,795	£2,494	£3,477
Rents of meters	119	1	1
Public lighting	384	504	529
Sale and repairs of lamps, &c. ..	248	273	523
Expenditure—			
Manufacture of electricity ..	805	952	1,202
Distribution and management ..	447	490	736
Rents, rates, and taxes	97	84	96
Debt redemption	277	277	277
Interest on capital debt	715	715	715

The increase under the head of distribution and management is mainly due to "cost of labour and fitting upon consumers' premises, and lamps sold," which accounted for £486 0s. 7d. in the year just closed, compared with £295 12s. 3d., for the preceding 12 months. Capital expenditure upon the electricity works amounts to £28,662 13s. 5d., an increase during the year of £4,451 9s. 1d. The premiums obtained on the Corporation 3 per cent. redeemable stock, less compensation to mortgagees again brought forward, reduces this amount by £319 17s. 8d. During the year a reserve fund has been commenced, and £200 placed to it. The amount set aside for the redemption of stock, with interest accrued on investment, is £1,159 10s. 2d. Taking into consideration the sum of £4,896 18s. 9d. owing to the treasurer, and the £41 11s. amount of cash in hand, the liability of the Corporation on the electricity department is £25,221 12s. 10d.

Lynn.—The Town Council has decided to extend the electric light mains so that all the streets at present lighted by gas shall be lighted electrically, and application is to be made to the Local Government Board for power to borrow £2,500 to meet the cost.

Maidstone.—Messrs. Stevens & Barker, electrical engineers, of Maidstone, have, in accordance with instructions from the Urban District Council, prepared and submitted a scheme for the electric lighting of the town, in which they have such confidence that they are prepared to forfeit their commission should the installation not prove a success. Messrs. Stevens & Barker propose having for generating plant two high speed engines to develop 110 brake H.P., directly coupled to dynamos capable of supplying continuously 75 kilowatts each, and one high speed engine to develop 220 brake H.P., and directly coupled to a dynamo capable of supplying 150 kilowatts, the engines and dynamos to be made extra strong so as to supply current under rapidly varying loads for tramway work if required, and the condensers to be supplied from a tank of 7,000 gallons capacity in the roof of the building, fed by a duplicate set of motor-driven centrifugal pumps. Messrs. Stevens & Barker estimate the cost of the work of installation at £22,319.

Manchester.—The Corporation are making active preparations to carry out the tramways municipalisation scheme in the city. The Electricity Committee have accepted the tender of the Westinghouse Electric Company, Limited, for the supply and erection at the Bloom Street generating station of four 1,800-kw. combined engine and dynamo machines. In connection with the scheme a statement was made by Councillor G. K. Ashton at a meeting of tramway employés held the other day, that during the next two years a stupendous amount of work would have to be accomplished in preparing and equipping the lines for electric traction and the provision of about 600 electric cars. The Manchester system would consist of about 100 miles of rail. It was anticipated that the expenditure on the work would entail an expenditure of about a million pounds sterling.

Morley.—The Town Council has appointed Mr. Herbert Drewett, borough electrical engineer, at £150 per annum.

Newton Abbot.—A Bill confirming the provisional order granted by the Board of Trade to the Urban Electric Supply Company has been issued.

Oswestry.—At the last Council meeting it was reported that at a committee meeting of the Council the town clerk read a letter from the Oswestry Electric Light Company, offering to sell the undertaking for £11,750, and further stating that extra machinery purchased by the company since the offer was made must be paid for in addition. He also read a report from Mr. Hawtayne, the expert consulted, stating the value of the works to be £8,220 10s. 4d. It was afterwards resolved, on the motion of Councillor Daniel, that Mr. Hawtayne be requested to attend a special meeting to be called

by the Mayor, and that at such meeting a committee be appointed to negotiate with the Electric Light Company, and arrange for the purchase at a price not exceeding the amount to be fixed by such meeting.

Shoreditch.—The Vestry on Tuesday elected the members of the Lighting Committee for the ensuing year. On a ballot, Mr. S. G. Porter, late chairman of the Vestry, received the highest number of votes for the committee, viz., 50, whilst Mr. H. E. Kershaw was second with 49 votes. The selection of a chairman was left for the decision of the committee. The Lighting Committee reported that they had received quotations from Messrs. Green & Sons, Limited, for the supply of an additional economiser at a cost of £410 8s., and from Messrs. G. and J. Weir, Limited, for two feed pumps capable of dealing with 3,000 gallons of water per hour at the price of £95 each. On the advice of Mr. Newton Russell, chief engineer, the committee stated that they had accepted the quotations, and the Vestry approved their action.

Stirling.—Satisfactory progress is being made with the Corporation electric lighting scheme under Prof. Kennedy. The works will be situated on a site adjoining the Caledonian Railway. The buildings are pretty well advanced. The system is a three-wire with 460 volts across the outers, the pressure at the lamps being 230. Two Lancashire boilers, 28 feet by 8 feet, are to be supplied by Messrs. Anderton, while the engines, dynamos, steam piping and economiser are to come from Messrs. Mather & Platt. There are to be two 120-I.H.P. engines and dynamos, and two 40-I.H.P. engines, each driving two dynamos, two feed pumps, a feed tank and an economiser. There are two batteries of 125 cells of 250 ampere-hours each, and two 3·5-kw. boosters driven by a motor. The battery is in the hands of Messrs. Pritchetts & Gold, and Messrs. James White & Co., Glasgow, are supplying the switchboard. The arc lamps for public lighting are by Brockie Pell, and the pillars by Messrs. W. M'Farlane & Co. The Corporation have arranged a very complete network of mains. Nearly the whole of the residential portion of the burgh has been mapped out, and all the business thoroughfares will be provided for. The mains and street connections are being supplied by Messrs. Callender, who have commenced work. The mains are triple concentric armoured cable, laid direct in the ground. The outermost conductor is the middle wire, and is earthed at the station. The estimated cost of the contracts at present in hand is about £25,000. The scheme is being carried out by the Lighting Committee of the Police Commission, the convener of which is Bailie Wylie. Already there are numerous inquiries from householders, shopkeepers, &c. Considerable fillip has been given to the Corporation's new undertaking by the negotiations between the British Electric Traction Company and the Local Tramway Company, and if the negotiations for the conversion of the tramway from horse to electric haulage are successful, it will be an immense advantage to the Corporation's station. The British Electric Traction Company intend constructing a new tramway from Stirling to Tillicoultry, tapping a number of fairly large villages along the route. The scheme is a very popular one locally, and the company is likely to be well supported by all classes. The main difficulty, however, is the absorption of the Stirling and Bridge of Allan Tramway Company, whose line at present covers a small portion of the route.

Stoke-on-Trent.—The Parish Council has asked whether the Rural District Council would sanction the former body erecting electric lighting plant on land adjoining the sewage works, and would allow the use of the boilers at those works for working the electric lighting plant.—Mr. Sugden, the surveyor to the District Council, said that the boilers would be quite adequate for the work suggested for some years to come. He had not gone fully into the question of the cost of an installation, but he was of opinion that, in view of the plant being worked by the sewage works boilers, 2d. per Board of Trade unit would cover the incidental expenses, and that the ordinary charge to customers of 6d. per unit would leave a considerable margin of profit. About 270 lamps of 16-C.P. would be required for street lighting. The cost of the installation would be £2,500. The proposal was well worthy of consideration. The District Council has deferred the question until the next meeting.

Sunderland.—Last Friday the electrical engineer reported to the Lighting Committee that the present accommodation at the electric light works would soon become inadequate to meet the demands made upon them. Only taking into consideration the natural development of the electric light, the works would become totally inadequate in two and a half years, but considering the power which would be required to work the tramways, the capacity of the works would not suffice for more than 18 months. The committee agreed that they must look out at once for land to provide increased accommodation, and a sub-committee was appointed to go into the matter.

Sutton (Surrey).—The *London Gazette* contains notice of the intention of the Urban District Council to transfer its provisional order to the County of Surrey Electrical Power Distribution Company. The company pays £500, and is to commence operations within six months, partially completing the works within two years, at least £5,000 to be expended. The Council may purchase after 10 years at a fair market valuation.

Todmorden.—A proposal that the Council put down electricity works is being held over for another month.

Wakefield.—The Corporation has resolved to raise the salary of the electrical engineer, Mr. J. K. Brydges, from £200 to £225 per annum, and by £25 per annum up to £300.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aberdare.—It is stated that opposition will be made to the application of the British Electric Traction Company to construct a light railway at Aberdare (the centre of a great Glamorganshire coal district). The grounds of opposition from several sources appear to be that the company is one of strangers and not of residents; that the railway will not be in the hands of the municipality, but in the hands of capitalists outside; and, again, that there may be possible damage to the road piping along the routes of the proposed new line in one form and the other.

Aston.—A member of the Council gave notice to bring forward on Tuesday last a motion that, as the Council was to take action *re* its electric lighting order, the purchase of the Birmingham and Aston Tramway Company's lines, &c., should be also taken into consideration. He suggested that the General Purposes Committee consider both matters with the aid of whatever expert assistance might be necessary.

Auckland (N.Z.).—According to the *Financial Times* the whole tramway system of Auckland is about to be equipped with electrical plant by an English company, at an estimated cost of £160,000.

Batley.—It is probable that before the year 1901 electric tramways will make their appearance in Batley. A municipal system of electric lighting, too, may with safety be predicted before that time. The idea is, says the *Leeds Mercury*, that the Corporation should purchase a portion of the rights of the company, who now run antiquated steam cars between Dewsbury and Gomersal; that they should enter into some arrangement with the neighbouring authorities for the working of all or part of the existing line; that they should adopt the overhead electric system of traction for the cars, and provide the requisite current from an electric generating station, which should be made large enough to supply electricity also for the lighting of the principal streets and for private lighting. Details are being considered by a Corporation sub-committee.

Bournemouth and Poole.—Sir Courtenay Boyle, on behalf of the Board of Trade, has been hearing objections raised by frontagers against the above light railway proposal. The residents of Parkestone objected that, as they had steep gradients down to the new line it would be dangerous; and, further, the quietude of the neighbourhood would be destroyed. Sir Courtenay Boyle said the objectors would have to show that it was not only unnecessary, but that it was undesirable. Mr. Gregory, for the objectors, said his case covered both points. The inhabitants were already well provided for by a railway, and the scheme would never have been heard of but for two rival companies coming into the district to provide what was not wanted. Mr. Sydney Morse said they had the unanimous support of the Town Council of Poole in favour of the scheme, and, the Light Railway Commissioners having determined the local questions at an inquiry, he submitted that the petitioners could not be heard. Sir Courtenay Boyle over-ruled this objection, but reserved his decision on the general question.

Brighton.—A deputation from the Town Council last week inspected the Halifax electric trams.

Cheltenham.—A Light Railway Commissioners' inquiry will be held on June 23rd regarding Mr. Thomas Nevin's electric scheme. It seems that a good deal of the opposition has now been dropped, notably that of the Gloucestershire County Council, who are now satisfied with the concessions which have been made.

Croydon.—On Monday the Council discussed the question of purchasing and working the trams on the report of a special committee, which advised purchase by agreement, and electrical working. The purchase would cost £50,000, and would be completed in September. The approximate costs of the different systems of traction were given as follows:—

Cable system	£9,000 per mile.
Underground conduit	10,500 ,,
Accumulator system	5,145 ,,
Surface system	12,000 ,,
Overhead trolley system	6,500 ,,

The overhead system was considered to be the most efficient electrical system. The entire cost would be something like £142,000. That would include the whole purchase and the relaying of the entire track, and a three-mile extension, but it would not include the cost of the generating machinery. After discussion it was decided to adjourn, and the Mayor fixed Monday, the 15th, as the date of a special meeting of the Council to discuss the question fully.

Darlaston.—The General Purposes Committee of the Urban District Council of Darlaston have considered the terms submitted by Mr. Lycett on behalf of the British Electric Traction Company with regard to the widening of the various portions of the roadway along the route of the proposed light railway, and the committee recommend that the proposals of the company be accepted subject to a proper agreement being entered into embodying the conditions and other clauses with respect thereto as may be considered advisable.

Darlington.—The Town Council had before it last week the question of the new tramway system proposed to be adopted between Darlington and Stockton. It was recommended by the committee that members should visit various towns where the electric tramway system had been in operation for the purpose of gaining information.

Derby.—The Tramways Committee of the Corporation have under consideration a joint report of the borough surveyor and the electrical engineer upon electric traction, and they are now engaged in inspecting the tramway systems adopted in other towns. The system in Derby comes into the hands of the Corporation at the end of the present month, and it is expected that electric traction will supersede the present means of working them, especially as extensive alterations and additions are about to be made to the electric light works.

Derby-Ashbourne.—The Derby and Ashbourne light railway scheme still hangs fire, and the objections of the Derby Corporation to the form of rail and other matters in connection therewith will be heard by the Board of Trade on June 14th. On that date the Highways Committee will attend before the Board with their advisers and witnesses in support of their objections. It was hoped in many quarters that the railway would have been ready this summer, but it seems as far off as ever.

Dewsbury and Spen Valley.—On 2nd inst. a conference was held at the Town Hall, Cleckheaton, in connection with the proposed electric tramway from Dewsbury to Cleckheaton. Representatives of the Dewsbury Town Council and of the Heckmondwike and Cleckheaton District Councils were present.

Dudley and Stourbridge.—The Board of Trade have allowed the Dudley, Stourbridge and District Tramway Company to use steam on their line for a month longer, pending the completion of the electrical equipment.

The reconstruction of this line is proceeding so rapidly that it is expected the electric cars will be running in the course of a month or six weeks.

Exmouth.—An electric tramways scheme for Exmouth is said to be under consideration.

Fleetwood to Morecambe.—The Lancaster Rural District Council has assented to the scheme for constructing an electric railway from Fleetwood to Morecambe, which will pass principally through their district and over the Lune Estuary. They also approved a proposed light railway from Knott End to Lancaster, the object of which is to facilitate the transfer of produce from the Fylde to the Blackpool, Lancaster, and Morecambe markets. The Lancaster Corporation object to the latter, and the Lancaster Port Commissioners to the former.

Halifax.—On 6th inst. the new portion of the electric tramways from Free School Lane to King's Cross, *viâ* Savile Park was opened, it having been previously passed by Sir F. Marindin on behalf of the Board of Trade. This makes the fourth new route opened this year, all having been laid down and equipped within seven months.

Hawick and Jedburgh.—A conference took place last week between the Hawick provost and magistrates and those of Jedburgh relative to the proposal to construct a light railway between the two towns.

Kingston.—A conference of representatives of local authorities in the county of Surrey, convened informally by the chairman of the Surrey County Council, was held at Kingston on Tuesday to consider the proposals of the London County Council to construct a light railway along the road from Wandsworth to Kingston, and presumably thereafter on other main roads leading out of London. Kingston, Richmond, Wimbledon, Croydon urban and Croydon rural districts, Carshalton, Banstead and several other districts were represented. The *Times* says that it was unanimously resolved:—"That, in the opinion of this conference, any proposal of the London County Council to make light railways or tramways in the administrative county of Surrey is unnecessary until the Surrey County Council and the local authorities in the county have had time to decide upon their own action." It was resolved that a committee should be appointed to consider the matter further and report to an adjourned conference.

Leamington.—The Town Improvement Association is asking the Council to take all possible steps to prevent the disfigurement of the town by the adoption of the overhead trolley system.

Light Railways.—Applications for orders to authorise the construction of light railways under this Act are made half-yearly to the Light Railway Commissioners in the months of November and May. In May of this year 40 applications for orders were made, and in the preceding November 54, a total of 94 for the year. In the previous years the numbers were 65 and 56 respectively. For each successive year since the Act came into effect, the estimated cost of constructing the lines applied for, exclusive of the capital expenditure upon equipment, promotion, &c., has amounted to the sums of £2,903,072, £4,652,904, and £6,722,963 respectively.

The Board of Trade have recently confirmed orders authorising the construction of light railways from Colwyn Bay to Llandudno, and the construction of light railways in the parishes of Barton-upon-Irwell and Stretford, Lancashire.

Liverpool.—The Overhead Railway late service has proved so satisfactory between Pierhead and Seaforth, that additional trains are to be run.

The Tramways Committee last Friday received a deputation of aggrieved tradesmen who represented that injury had been done to their business owing to the diversion of traffic by the electric cars *viâ* Park Road. It was complained that property was decreasing in value, and tradesmen's receipts had fallen off through the electric trams going down other streets. Speakers suggested additional lines, so that their streets might be served also. The committee has the matter under consideration.

The city and electrical engineers and the general manager have been instructed to prepare a scheme of trams to Walton and Aintree.

Newcastle.—The Tramways Sub-Committee has been corresponding with the lessees of the tramways without result, and the committee favours the Corporation taking over the tramways when the lease terminates on November 13th next. Mr. Laws, the borough engineer, is to report as to the estimated cost of buying out the present company, and also as to the probable cost of purchasing a sufficient number of cars which may afterwards be available as trailer cars for the new electrical system.

Newport (Mon.).—The borough engineer, Mr. Haines, is preparing a report upon the question of adopting electric traction for the Newport tramways.

Peterborough.—On Tuesday a representative of the British Electric Traction Company was to attend the Council meeting to discuss the electric tram scheme. The scheme is an eight mile one, and the generating station is to be erected on the Wood Fair meadow between the town bridge and the L. & N. W. railway.

Reading.—The Town Council has adopted recommendations of the Tramways Committee as follows:—

That the Council do provide a generating station, and the requisite plant and machinery for generating electrical power for the working of the Corporation tramways. That, subject to the committee making satisfactory arrangements as to terms with Mr. I. E. Winslow, of 35, Parliament Street, Westminster, that gentleman be retained as electrical engineer to advise the committee and the Council on all matters upon which the committee may deem it advisable that his assistance should be given in connection with the system of tramways to be laid down in accordance with the resolutions already adopted by the Council and as to the generating station and the plant and machinery requisite to supply electrical power. That, subject to arrangements being made with the electrical engineer and expert, the borough engineer and surveyor be requested, in conjunction with the electrical engineer and expert, to prepare the requisite plans and sections of the proposed system of tramways, including the generating station plant and machinery, and that they be authorised, if they deem it expedient, to provide in such plans for the appropriation of any part of St. Giles' mill property and the property of the Corporation adjoining Caversham Bridge on the east side of Caversham Road for the purpose of generating stations or depôts.

Salonica and Smyrna.—It is stated that Sir Ellis Ashmead-Bartlett has been granted a concession for electric lighting and electric traction in Salonica, and for traction only in Smyrna.

Sheffield.—In the city accountant's accounts of the Corporation tramways, he gives various figures showing the total cost of the construction of the electric tramways to March 25th last as £144,370.

Wolverhampton and Bridgnorth.—Some 16 years ago an Act of Parliament was obtained for the construction of a railway from Wolverhampton to Bridgnorth, and had the line been made it would undoubtedly have proved a great boon. But the scheme was never carried out, and now, under the Light Railways Act of 1896, an order is being asked for by the promoters—Mr. James Heath, M.P., Mr. Beresford Melville, M.P., Sir Henry Seymour King, M.P., and Mr. J. T. Firbank, M.P.—enabling them to construct three distinct lines, which will connect the two towns. The railways are to be constructed on a gauge of 4 feet 8½ inches, and the motive power proposed to be used is steam or electricity. The land required is estimated at about 240 acres.

TELEGRAPH AND TELEPHONE NOTES.

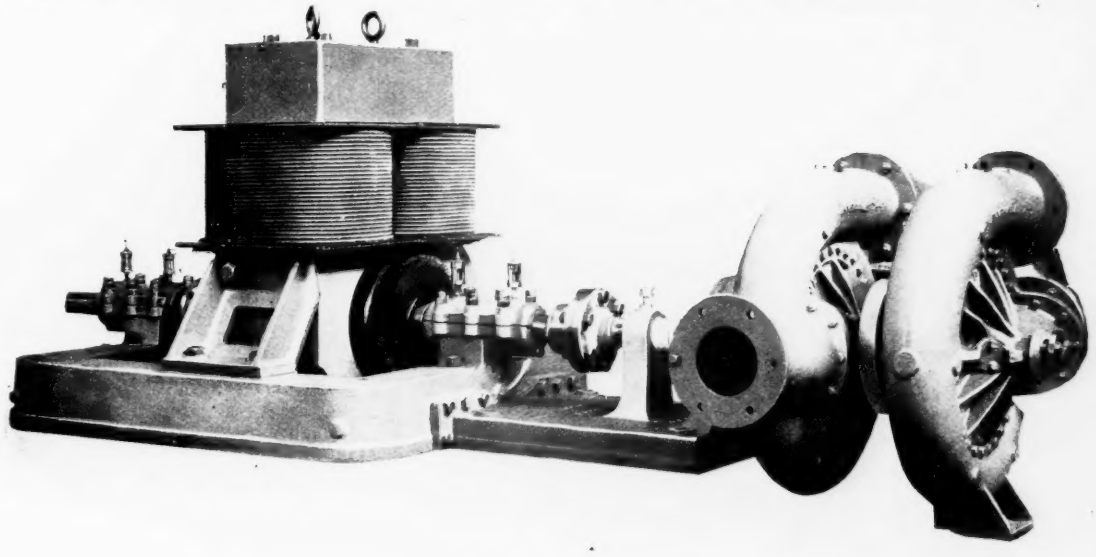
Delay to Telegrams to South Africa.—It is unfortunate that just when matters are in a critical stage in South African politics the means of communication with the Cape is found wanting. At present, owing to the interruption of the Mozambique-Delagoa Bay cable along the East Coast of Africa, which broke down on May 26th, which was laid 20 years ago, and which is not duplicated, telegrams from South Africa suffer considerable delay. We observe that telegrams from Pretoria and the Orange Free State, where the conference between Sir Alfred Milner and President Kruger was being held, dated June 5th, were published in the daily press of the 7th, with the footnote, to which we have become accustomed in connection with any political crisis in South Africa, "delayed in transmission."

German Telegraphs to the East.—In view of the active steps now being taken by Germany for the establishment of railways and telegraphs into Persia, a project, which has been strongly opposed by a British combination in Constantinople, we observe that Her Majesty's Government are taking steps in the Persian Gulf to assure the predominant position which the English Government should certainly maintain there. In connection with this subject we learn that the conduct of political affairs on the coast of Mekran is to be taken out of the hands of the Director of Posts and Telegraphs at Karachi and that a special agent is to be appointed, and that cables are to be laid between Muscat, Jask, Bundar Abbas, and Charak, a length of about 450 nautical miles. It is reported from Berlin that an agreement has been arrived at between the German Government and the Eastern Telegraph Company. According to its stipulations the company will raise no further objections against the cable concession between Constantinople and Constanza granted by the Sultan to Germany, but of this report we have no confirmation.

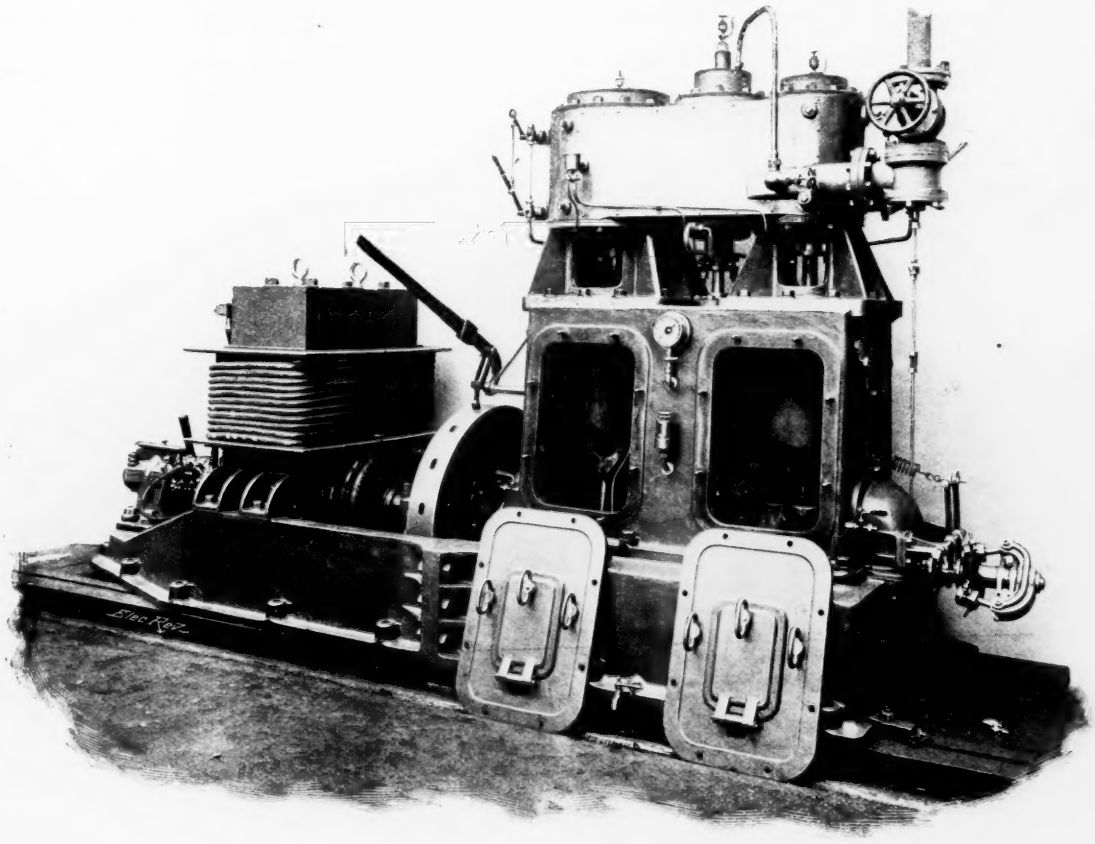
(*Continued on page* 944)

ELECTRIC PUMPING IN MINES.

We suppose one can hardly charge colliery owners with adopting electrical methods in too great haste. Manifest as were the advantages of electric power to the electrical engineer, it has been an uphill task to convince those having English mines under their control that it would pay them well to abandon the old-time methods and substitute electrical machinery. Strikes have come and strikes have gone, and it is quite within the scope of possibility that trouble may arise again, notwithstanding the fact that recent strikes have resulted in strengthening the hands of the employer. The adoption of electricity for cutting, pumping, hauling, and the many other classes of work in a mine, reduces the amount of labour to a minimum, and, generally speaking, results in such economies as enable the owner to recoup himself for the outlay in a comparatively brief space of time.



Combined Centrifugal Pump and Motor.



Tyne Dynamo, with 150 B.H.P. Engine.

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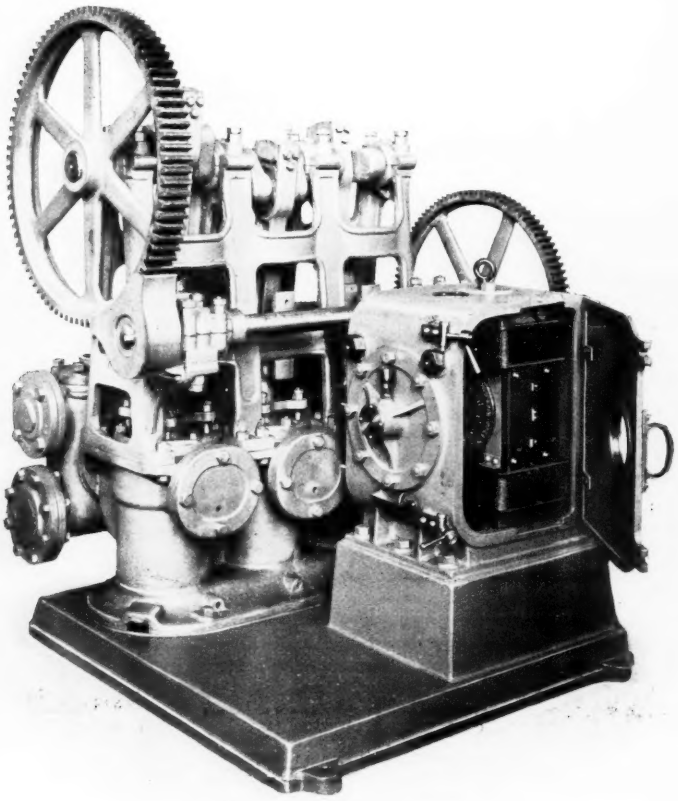
The manufacturer is only just beginning to realise what enormous advantages and economies are to be obtained from the employment of electric motors for machine and tool driving in ordinary factories. The figures issued not long ago showing the success of electric driving at North Country shipyards, steel works, &c., served to point out what a great future lies in store for this system. One would not have much difficulty in quoting instances where equally satisfactory results have been obtained in mining work.



Glasgow Subway Pump and Motor.

Electric pumping machinery forms a very necessary part of the equipment of an up-to-date mine in which the officials leave no stone unturned to prepare themselves for coping speedily with the encroachments of water. The South Staffordshire mine-owners have for a long time past been considering a very large scheme whereby they are hoping, when the Midland Power Distribution undertaking is able to commence supply, to employ electricity for pumping purposes in connection with mines' drainage. This will be an important scheme, and as the Midland Company now looks like getting on with the erection of generating works, it will doubtless take practical shape very soon.

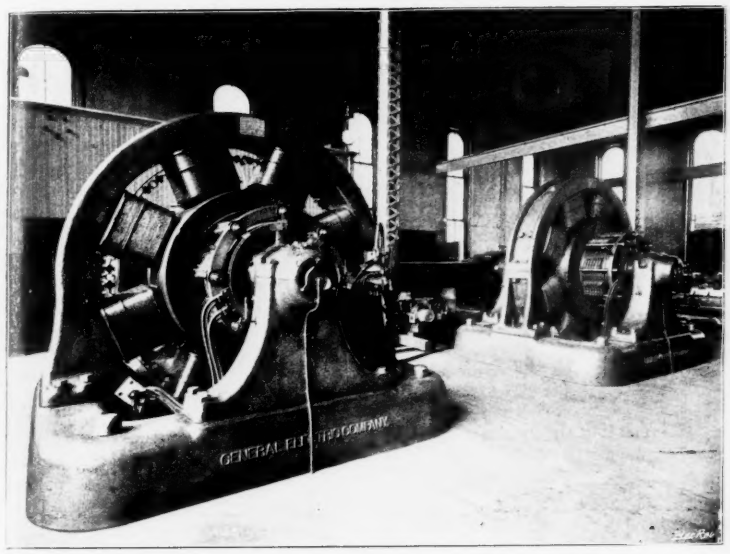
To a large extent we suppose that electric mining equipments have been developed in the hands of two or three electrical engineering firms, and in the front rank of these few must stand the name of Messrs. Scott & Mountain.

We illustrate in connection with this article some of the special sets of plant which have been made by this firm from time to time, these, of course, being only specimens of a great number of other sets of machines supplied in connection with electrical power transmission in all classes of mining and colliery work since the firm commenced their manufacture many years ago.

St. Anthony's Falls: Exterior View of Power House.

Some time ago they were approached by the managers of a large ironstone mine in the North of England, who were

desirous of unwatering one of their mines that had lain idle for some years, and in which the water had accumulated to a depth of over 200 feet. In order to have a pumping plant that could easily be moved about as the level of the water was lowered, Messrs. Scott & Mountain designed the com-



St. Anthony's Falls: Rotary Converters in a Sub-Station.

bination of centrifugal pump and electric motor shown in one of the accompanying illustrations.

The output of this pump against a head of 100 feet is 1,000 gallons per minute, and when lowered to the bottom of the mine where the water would have to be raised 300 feet it would still deliver as much as 750 gallons.

To generate the current required by the motor, Messrs. Scott & Mountain supplied one of their well-known Tyne dynamos, driven by a vertical compound engine of 150 brake horse-power, but capable of developing 200 B.H.P. when running condensing. This engine, shown on page 939, is controlled by a Proel governor, and is constructed to run at a constant speed of 125 revolutions per minute.

The illustration on page 940 represents a smaller combination of pump and electric motor, the latter being one of Scott and Mountain's enclosed type, built to run in position where there is much dust or dirt about, or where the motor is liable to injury from any cause and has to be specially well protected. This plant, together with three others of identical design, was supplied for use in the Glasgow District Subway for pumping from the tunnels, and very satisfactory results have been obtained from their use.

The motors are of the firm's latest design, and develop about 2 H.P. each at a speed of 1,225 revolutions per minute, the power being transmitted to the pump by means of spur gearing.

The haulage plant is of special design constructed to draw an average load of 25 cwts. at the rate of 100 feet per minute, with sufficient margin of power to easily do its work if the load be increased to 35 cwts.

The motor is connected to the drums by means of machine cut worm gearing, the steel worm revolving in a bath of oil, so that a maximum of power is obtained with a minimum of noise and loss by friction.

Messrs. Scott & Mountain have recently installed some very large electrical transmission plants in the North of England, in Scotland and in South Wales; and it is to be hoped that as engineers and mine managers come to appreciate more and more the many advantages electricity offers, particularly for work similar to that described above, most of the prejudice that undoubtedly still exists against this method of transmission, will be overcome.

In the case of the centrifugal mining pump first referred to, it does not need any special training to grasp the fact that no other system of conveying power from the surface to a movable machine underground can approach electricity in general convenience and utility. The unwinding of a few coils of cable from a drum, and even the suspending of it from the roof or walls of the tunnel, are a very small matter compared to the laying and careful jointing and fixing of pipes that would be required in the case of compressed air or steam, the only two formidable rivals to electricity in this class of work.

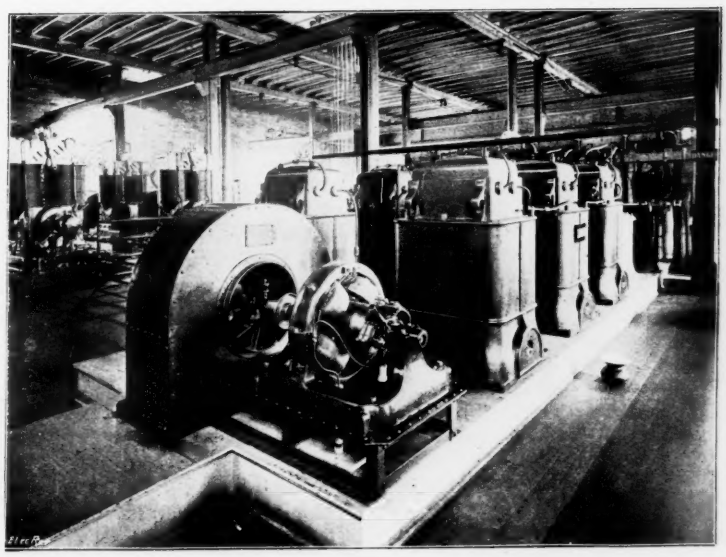
ST. ANTHONY'S FALLS WATER-POWER PLANT.

(*Concluded from page* 902.)

The commutator is designed so that the current density at the point of contact with the brushes does not exceed 35 amperes per sq. in. at the full rating of the machine, and the difference of potential between commutator bars is very low.

There are two 100-kw. six-pole exciters, running at a speed of 280 revolutions per minute, and wound for a voltage of 575 volts at no load, and over-compounded to 600 volts at full load. These machines have armatures of the ironclad type, ventilated in practically the same manner as the machines previously described.

The switchboard installed in the station was especially designed with a view to having two separate sets of bus bars, so that the attendant in charge may run any particular machine on either of the two bus bars. The switchboard consists of 23 panels, as follows:—



St. Anthony's Falls: View of Transformers.

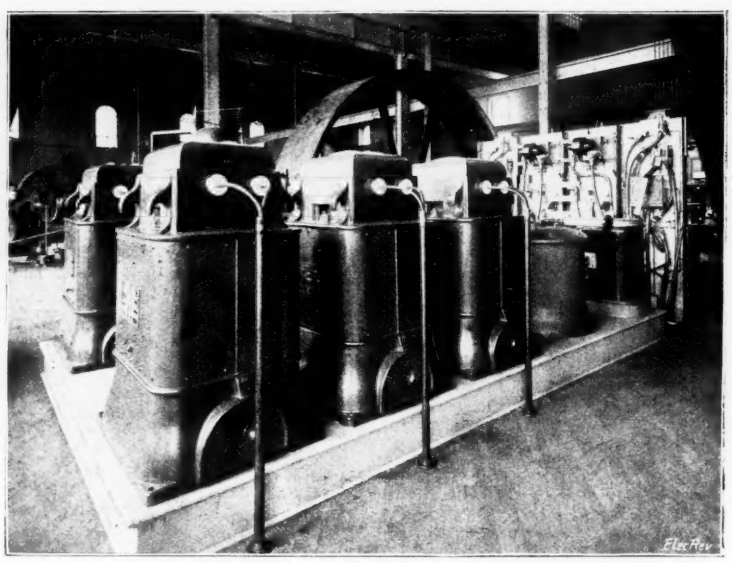
One station panel, equipped with one 750-volt illuminated dial Weston voltmeter, one 2,500-ampere, 600-volt Thomson recording wattmeter, the panel being surmounted with a 12-inch dial eight-day clock and head-piece.

Five alternating current generator panels, each equipped with one 200-ampere, dead-beat, inclined coil ammeter; one 5,250-volt inclined coil voltmeter and station transformer;

one generator rheostat; one high-voltage main switch (porcelain chamber); two single-pole field switches; one two-point phase lamp switch; two pilot lamps; one phase lamp; one potential plug; one 700-kw. single-phase indicating wattmeter and three fuse blocks.

Niagara Suspension Bridge. (See page 944.)

Two continuous current railway generator panels, each equipped with one 1,200—2,000-ampere circuit breaker; one 2,500 ampere illuminated dial Weston ammeter; one generator rheostat; one lightning arrester; two single-pole, double-throw main switches; one lightning switch; one two-way field switch; one potential plug; one pilot lamp; one resistance lamp; two bus wires on the back. (Equaliser switches are furnished, but are located at the generator).



St. Anthony's Falls: Transformers.

Five alternating current feeder panels, each equipped with one 200-ampere, dead-beat, inclined-coil ammeter, one 200-ampere, 3,500-volt alternating three-phase Thomson recording wattmeter, and two station transformers; three porcelain chamber, high voltage triple-pole switches; one pilot lamp; six bus bars at the back; one indicating wattmeter, 700 kw. capacity (single-phase type), and three fuse blocks.

Eight special railway feeder panels, each equipped with two 300—500-ampere, circuit breakers; two 200-ampere, round pattern, Weston ammeters; one pilot lamp; two single-pole main switches; two bus bars at the back.

Two exciter panels, each equipped with one illuminated dial Weston voltmeter; one round pattern Weston ammeter; one rheostat; two single-pole, double-throw, main switches; two single-pole field switches; two bus bars at the back; one automatic circuit breaker.

The static transformers employed in this plant are of the standard air-blast type, and are 21 in number, of 233 kw. capacity each. Six of these are placed in the main station for the purpose of raising the generator voltage from 3,450 to 6,900 volts, and the remaining 15 are placed in the three sub-stations, two containing six, and the third three.

This type of transformer is too well known to need an extended description, although it might be interesting to refer to some of the most important features of its construction.

The first and greatest aim in the manufacture of any transformer is to thoroughly insulate the high potential from the low potential windings. This is accomplished in this transformer by the method of cooling, which admits of a heavy insulation being placed on the coils without unduly restricting the radiation of heat. In addition to this, solid diaphragms of heavy insulation are placed between the high and low potential coils. Air ducts separate this diaphragm on either side from the adjacent coils.

How effectively this insulation fulfils its duty may be judged from the fact that the transformers for this plant were tested with a 20,000-volt potential between primary and secondary windings, and it could have safely been tested for considerably higher voltages. Transformers of this type have been built for higher voltages with similar insulation, and have successfully withstood a test of 80,000 volts.

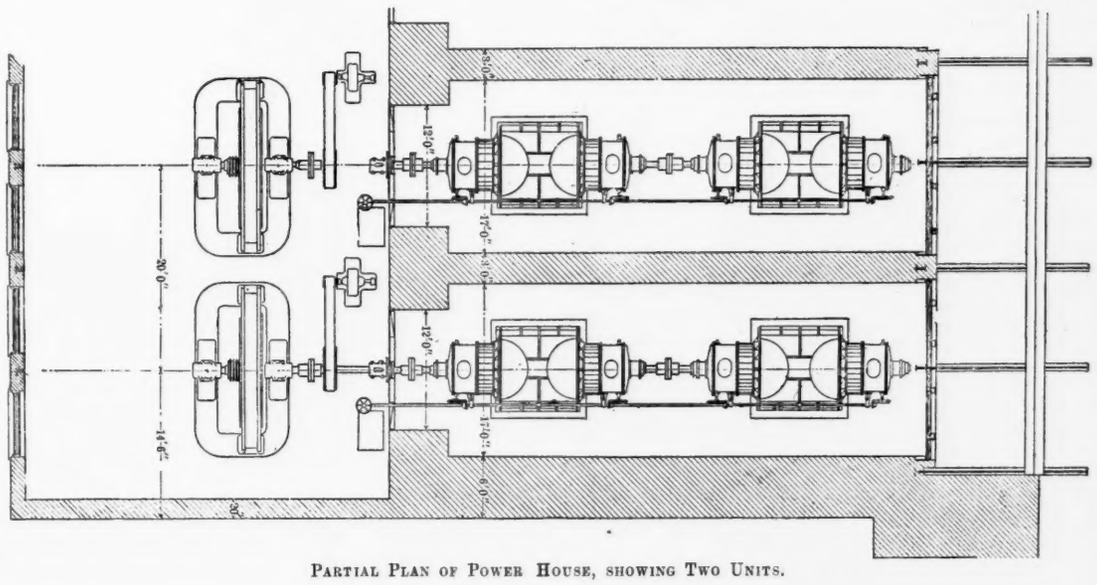
Another one of the problems connected with the building of large electrical apparatus is to properly dispose of the heat generated within the windings. This problem has been very successfully met in electrical apparatus which has revolving parts by so designing these parts that they act as blowers, thereby forcing currents of air through the revolving parts. It is not surprising, then, that this method, which has proved so thoroughly satisfactory in revolving apparatus, should prove equally satisfactory in static transformers.

In order to present the proper amount of surface to the circulating air, the coils of the transformers are separated from each other by narrow air ducts, and the sheet iron of which the transformer case is composed is separated into small groups by similar ducts.

The air is forced through the main duct which runs underneath all of the transformers. This forced draught is obtained from an electrically-driven blower set, and the air, after passing through the coils in the core, escapes into the surrounding atmosphere, having absorbed the heat in its passage through the transformers.

Niagara Suspension Bridge. (See page 944.)

So carefully and thoroughly has this system been carried out, that each transformer has some 350 square feet cooling surface. As a result, no portion of the windings has a temperature rise of more than 35° C. above the surrounding air after having carried their full rated load for an indefinite time.



Partial Plan of Power House, showing Two Units.

It is a fact worthy of note that this very effective cooling is accomplished with an expenditure of power of $\frac{1}{10}$th of 1 per cent. of the capacity of the transformer.

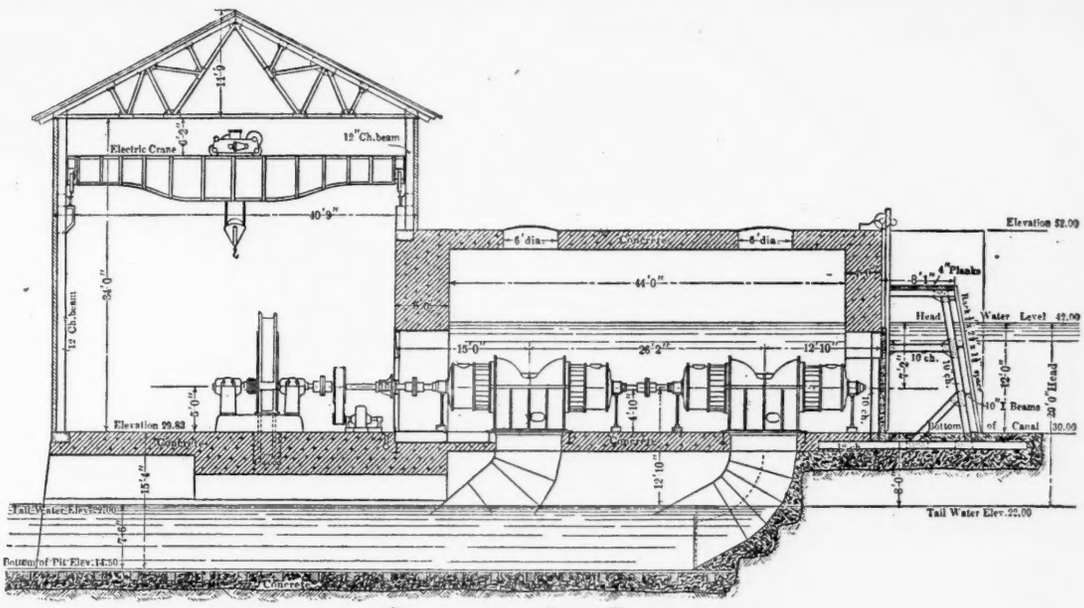
The efficiency of these transformers is a fraction under 98 per cent. While this is not as high an efficiency as can be obtained in the design of transformers, it represents practically the most economical design where power is as cheap to produce as it is in this plant. Good regulation rather than extremely high efficiency is, of course, to be desired in water-power plant, and consequently the transformers were designed for the very close regulation of 1 per cent. from no load to full load.

The transformers are thoroughly protected by an enclosure case, no portion of the windings being exposed. The high potential coils have their terminals brought out through the casing in porcelain bushings, and rubber-covered cables connect these terminals to the lines.

A three-phase open magnetic circuit inductance coil is placed between the transformer and each rotary in order to give greater range of adjustment of the direct current voltage of the rotary.

On most power transmissions there is sufficient inductance in the system, due principally to the inductance of the line, to allow a considerable range of adjustment in the voltage of the rotary by changing the field excitation, without any considerable idle current being produced.

In this transmission, due to the comparatively short distances between generator and rotary and to the extensive use of cable rather than overhead line, the inductance of the system is so low that the introduction of this artificial inductance is necessary in order to get the desired flexibility in the voltage.



Cross-section of Power House.

There have been installed in the three sub-stations five rotary converters. Two of these converters are in what is known as sub-station No. 1, located in the heart of the city of Minneapolis, and are 9,000 feet from the power station, current being transmitted at a pressure of 3,500 volts over two triple-conductor, paper-insulated, lead-covered cables, each conductor equal to 3—0 B. and S. furnished by the National Underground Conduit and Cable Company; one

is in sub-station No. 2, located in Minneapolis, and 23,700 feet distant from the power station, and operated at the same potential as No. 1 station, by one triple-conductor cable, each conductor equivalent to 4—0 gauge; two are in sub-station No. 3, located in St. Paul, distant 10 miles from the power station. The current is transmitted at a potential of 12,000 volts through one triple-conductor cable, made up of three 1—0 B. and S. wires.

These converters are of the 8-pole type, of 600 kw. capacity each, and operated at a speed of 530 revolutions, giving 580 volts on the direct current sides at all loads up to normal.

The armature is of the ironclad type, and is thoroughly ventilated by means of $\frac{5}{16}$-inch ducts. The armature spider is calculated for a safety factor of 6, and so constructed that all shrinkage strains are obviated; the lamiræ are dove-tailed into the armature spider, dispensing with the use of bolts in the core.

The commutator is assembled on a separate spider mounted upon the armature spider. The voltage delivered to the A.C. side of the rotaries is approximately 350 volts.

The switchboards for the three sub-stations consist of 10 blue Vermont marble panels, divided into three units, two having two alternating and two direct-current panels, and the other one alternating and one direct-current panel.

Each continuous current panel is equipped with the following apparatus: One 650-volt, inclined coil, dead-beat voltmeter; one 1,500-ampere, inclined coil, dead-beat ammeter; one pilot lamp; one potential plug; six single-pole, quick-break switches.

Most of these details have been taken from the *Street Railway Journal*, while the British Thomson-Houston Company have been good enough to lend us illustrations.

NIAGARA SUSPENSION BRIDGE.

THERE is now building across the Niagara gorge, near the famous Queenston Heights, a great suspension bridge, which, when it is completed, will be the only structure of the kind spanning the mighty and famous chasm where tourists find such rare delight. A peculiar fact in regard to the bridge is that it will occupy the identical site of a bridge that was built in 1851-52, and which was destroyed by a wind storm on February 1st, 1864. Another interesting fact is that the bridge is being built by the International Traction Company, the $15,000,000 syndicate that recently came into possession of all the electric traction roads in Buffalo, Niagara Falls and locality, as well as the upper steel arch that crosses the gorge near the Falls of Niagara. It is the company's intention to operate an international belt line around the gorge when its suspension bridge is finished. This will make a most delightful ride, and it is one that the great majority of those who visit the Falls will take.

The new bridge will have a cable span of 1,040 feet, while the suspended span will be 800 feet. The width of the roadway of the bridge will be 25 feet on the inside, a space that will afford room for a single track for electric cars running through the centre, and also for carriages to pass on either side of the track. The structure will be supported by four cables, each composed of 14 wire ropes $2\frac{1}{4}$ inches in diameter. These cables are now in position. The ropes of which they are made once formed the cables of the old upper suspension bridge at Niagara Falls. This old bridge had a much longer span than the new bridge, while the anchorages were located some distance back from the towers. This caused the use of very long cables, and for the new bridge these cables were cut in half, and the ropes so cut used for the cables of the new bridge. But in this form, however, the ropes are not long enough to entirely fill out the cable span and reach back to the anchorages, and for this reason eye-bars are used to piece out about 74 feet at each end of the cable span, and also from the towers back to the anchor pits. This is the first suspension bridge at Niagara ever constructed in this manner, and for this reason it is particularly interesting. It will also be the first suspension bridge to carry a trolley car across the river. The towers of the bridge are four in number, two on each side of the river. The towers on the New York side have a height of 26 feet, while the towers on the Canadian side are but 18 feet high. This brings their tops level with one another, owing to a difference in the height of the cliffs.

The towers stand on the top of the high banks, but the bridge, strange to say, will swing midway between the surface of the river and the tops of the cliffs. Its height above the river will be 65 feet, and it will be just 15 feet above the tracks of the Gorge road, the trolley line running through the gorge. This is quite unlike all of the suspension bridges at Niagara so well known to the public, for they were built even with the top of the river banks, fully 200 feet above the rapid running waters of the tumultuous lower Niagara. This location of the new bridge is similar to the structure above referred to as having been destroyed, and it will make it quite convenient for the electric cars to reach it from the gorge.

On both sides of the river long approaches to the bridge have been constructed, and these will have double tracks in order to afford cars every facility for passing off and on the bridge. The grade of these approaches is easy, and both run to the north, one toward Queenston Ontario, on the Canadian side, and that on the New York side toward the village of Lewiston.

Between the cables at the New York end of the bridge a large movable platform has been erected to accommodate the workmen who are placing the suspenders in order that the floor, beams and girders may be put in place. The work of erecting the steel will begin at the New York end and proceed toward Canada. As section by section is built the swinging platform will move out across the river, at all times affording the men safe quarters in which to work. It is not expected that the erection of the steel will occupy many months, for the parts will be put in place with wonderful rapidity, and before summer the structure will be ready for the electric car service between the two countries.

The metal that will be placed in the bridge will weigh 800 tons, while the cables will weigh 200 tons. The capacity of the bridge will be such that it will easily take care of the heaviest electric cars likely to be run in the Niagara region, together with a uniformly distributed load of 40 lbs. to the square foot over the entire structure.

The erection of this bridge recalls to mind the fact that the bridge that formerly occupied the site was built about 50 years ahead of the demands of the times. It was a wooden structure. A short time previous to the storm that ruined it, a great floe of ice passed down the river. It was evident to the bridge officials that the guys near the water's edge were in imminent danger of being torn away, and so men were ordered to hurriedly remove them up out of danger. This was done. The masses of ice passed on down to Lake Ontario. Fair weather followed. The men in charge of the bridge forgot to refasten the guys, and while in their loosened condition a hurricane swept down the canyon between the rocky cliffs. The bridge was soon swinging back and forth on the storm, and about eleven o'clock that morning a portion of the superstructure was torn from its supports, and fell into the river. As the bridge was not financially profitable, it was never rebuilt, and for years it continued to drop away piece by piece, until when the new bridge was started there was nothing but a remnant of the superstructure and the cables to cut away. But with the fall of these there passed away one of the most interesting of the Niagara landmarks.

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 938.)

German Cable Stations.—The *Times* Berlin correspondent says that the rumour that Germany had offered to exchange a cable station in the Carolines for a similar station in the Philippines is contradicted there. As the Americans already have Guam, in the Ladrones, it is rather difficult to see what special value another station in the Carolines would have for them.

The Pacific Cable.—The views of the Council of the British Empire League on this subject are quite clear. At the meeting held last Monday at Westminster, cablegrams from Colonel Denison, President of the League in Canada, urging the reconsideration by the Imperial Government of the proposals to support the establishment of a Pacific cable, were considered. It was moved by the Hon. W. P. Reeves (Agent-General for New Zealand), seconded by Mr. F. Faithfull Begg, M.P.:—(1) "That this Council notes with pleasure the action of the Australian Colonies and New Zealand, in offering to guarantee an increased proportion of the cost of an all-British cable, and expresses satisfaction that the Dominion of Canada is willing to share the remaining proportion with the mother country; (2) that in view of the undoubted value of the Pacific cable to the Empire, and of its probably profitable results as a commercial enterprise, the Committee expresses a hope that every effort will be made to overcome any obstacle that may delay the co-operation of the mother country in the undertaking." After a discussion, in which the Duke of Devonshire, Sir Frederick Young, Sir William Des Voeux, Sir Walter Peace (Agent-General for Natal), and General Laurie, M.P., took part, the resolutions were unanimously adopted. As this matter has been under consideration for the last 10 or 12 years, it seems almost inconsiderate to hope that the Government should come to any hurried decision.

Reduction of Cable Rates to India.—At a meeting of the Council of the British Empire League, held last Monday in the Grand Committee Room, Westminster Hall, under the presidency of the Duke of Devonshire, the following resolution was proposed by Lord Derby, president of the Liverpool branch, seconded by Sir Frank Forbes Adam, chairman of the Manchester branch committee, and unanimously adopted:—"That the Liverpool branch having drawn the attention of the Council to the excessive rates charged per word on cablegrams between the United Kingdom and India, it is hereby resolved that the Council shall use every means in its power to obtain a substantial reduction in such rates" It is doubtless such indications of opinion as these which inspire the editor of the *Investors' Review* with misgivings, if one may judge from the following remarks which appear in that *Review*. He writes:—"Something is evidently being done with reference to a reduction in the cable rate for India. As we have so often pointed out, the rate is relatively the highest to any important country—a state of affairs which does not reflect credit upon either the Government or the companies concerned. Merchants both in India and in this country have been moving in the matter, and according to advices from Simla, the Government is apparently bestirring itself. The best arrangement

would be to reduce the rate from its present figure of 4s. per word to about 2s. 6d., the possibility of loss by this change being divided between the companies and the Government. Arrangements on these lines have proved satisfactory in regard to Australia and the Cape, and there is no reason why equally good results should not be obtained in this case. It is always difficult to induce either Governments or companies to see the necessity for altering existing conditions, but the present agitation is likely to forward the desired object." This is very well as far as it goes, but one point seems to escape general attention as far as these Government guarantees go, and that is, that there are two ends to a cable route. Why Australia or India, as the case may be, should stand guarantee to procure a reduction of rates which is quite as beneficial to England as to either India or Australia or the Cape, according to the cable route concerned, is not very clear, nor does it seem at all equitable. The reduction of rates to India is quite as much an advantage to the man who sends a message from London to Bombay as it is to him who telegraphs from Bombay to London. Therefore, if a guarantee be asked for, the Home Government should share in this with the Government of India or Australia, as the case may arise.

A meeting of the Parliamentary Committee which has been formed with the object of securing a reduction of telegraphic charges was held last Friday, Sir E. Sassoon presiding. Mr. Henniker Heaton placed before the Committee a number of further statistics bearing on existing anomalies in the telegraphic charges. It was stated in the course of the proceedings that Lord Curzon had intimated his approval of a scheme for securing the reduction of the telegraphic rates between England and India from 4s. to 2s. per word, and that details of the scheme were on their way home, and would in due course come before the Government.

Reuter's Simla correspondent telegraphed on June 1st that a despatch has been sent submitting proposals to the Secretary of State for India to secure a reduction of not less than 50 per cent. on the present telegraph traffic between India and Europe.

Telegraph Communication with Cebu.—The Eastern Extension, Australasia, and China Telegraph Company announce that their Manila-Iloilo cable has been extended to the town of Cebu, thus establishing direct cable communication between Manila, Iloilo and Cebu.

Telegraphic Interruptions and Repairs:—

CABLES.	Down.	Repaired.
Bonny-Cameroun	May 29th, 1899 ...	...
Lourenco Marques-Mozambique	May 26th, 1899 ...	...
Para-Maranham	April 10th, 1899 ...	...
Assab-Massouah	May 23rd, 1899 ...	...
Amazon Company's cable—		
Cable beyond Garupa ...	June 11th, 1898 ...	...
LANDLINES.		
Communication between Salonique and Monastir.	March 16th, 1899 ...	...
Communication with Jérémié and Port de Paix (Hayti)	May 20th, 1899 ...	...
Communication with Swakopmund	May 18th, 1899 ...	...
Line between Antofagasta and Cochabambu (Bolivia)	May 9th, 1899 ...	...
Saigon-Bangkok ...	June 2nd, 1899	... June 3rd, 1899

Telegraphs in the Soudan.—We learn that the storm which washed away some six miles of the Wady Halfa-Abu Hamed Railway has also had the effect of temporarily interrupting telegraphic communication with Khartoum. Besides the "wash out" first reported, we are informed that the line suffered considerable damage beyond the point first reported as damaged.

Telephone Exchanges.—The usual return has just been issued as a Parliamentary paper relating to telephone exchanges opened by the Post Office in the United Kingdom. It seems, says the *Times*, that by the end of last year 49 such exchanges had been opened, of which seven are now without subscribers. On the last day of 1896, 1897, and 1893, the total number of subscribers was 1,151, 1,155, and 1,213 respectively, and the number of subscribers who have given notice to leave any exchange is 45. Seven new exchanges were opened last year.

The Telephone System.—On 2nd inst. a deputation from the National Chamber of Trade waited on Mr. Hanbury at the Treasury to urge the Government to proceed with the Telephone Bill during the present session. Mr. Hanbury, in reply, expressed his satisfaction at receiving so important a deputation. He felt so strongly that it was essential to make the telephone service as widespread as possible that he would be prepared, when the Bill was read a second time, to carry its proposals very much beyond the county boroughs, and to extend them to all urban sanitary districts.

It has been stated that Mr. Faithfull Begg, M.P., and Mr. C. McArthur, M.P., convened a conference of Members of Parliament favourable to the nationalisation of the telephones for yesterday at the House of Commons.

In the House of Commons last week on the vote to complete the sum of £3,638,390 for salaries and working expenses of the Post Office telegraph services, Sir J. B. Maple called attention to the greatly increased expenditure in the maintenance of the postal telegraphic services. He thought there was a great waste of money in this branch of the service. He instanced the case of some private wires which had been attached to his place of business by the Post Office. He had had an estimate from the National Telephone Company to supply the service at half the cost, and as the Post Office refused to amend their charge a change was being made, and the Post Office were taking down all their posts and wires for two miles and a half. He knew of a similar case in the same neighbourhood, and the same thing was also being done in the country. He thought that to lose business in that way showed bad management on the part of the Post Office.—Mr. Hanbury said the monopoly of the Post Office did not extend to wires, whether telegraph or telephone, between houses or properties belonging to private individuals. The service his hon. friend referred to was not essentially part of the Post Office work at all. In regard to such services they were in keen competition not only with the National Telephone Company, but with any company who might undertake the work, and as the Post Office had plenty of public work of their own to do, they had recently been rather unwilling to extend the system of private wires where the distances were comparatively short. The private wires they were perhaps willing to extend were the longer ones. For instance, they were now, he believed, laying private wires between London and Edinburgh. He could not undertake that the Post Office would go further than they had gone already. They had reduced the charges in private wires to a certain extent, and he was afraid that if his hon. friend was not content with their charges he would have to go to the National Telephone Company. After a short further discussion the vote was agreed to.

The Liverpool Chamber of Commerce has presented a petition to the House of Commons with reference to the Government's Telephone Bill. The petitioners state that as the result of their inquiries they find that the municipalities of the country are at present without knowledge of the actual terms upon which they should establish telephone undertakings, and they are not, therefore, in a position to express fully their opinions on the subject of the proposal. Not one of the 114 boroughs scheduled in the National Telephone Company's (No. 2) Bill is said to be likely to undertake a municipal telephone service in competition with the company. Further, it is known that the majority of municipalities support the principle of the nationalisation of the telephones. The petitioners, according to the *Times*, are in sympathy with the view of the London Chamber of Commerce, that the Telephone Bill should be withdrawn until the promised inquiry has been made into the subject of municipal trading. After setting out Mr. Hanbury's admissions and giving a general summary of the present position, the petitioners pray that the Government will reconsider the Bill, and will favourably consider the recommendation of the Liverpool and other important chambers of commerce of the United Kingdom, and will acquire, upon terms that are fair and reasonable as between the nation and the company's shareholders, the undertaking of the National Telephone Company, and work the whole system of telephones as a department of the Post Office, or as a separate department.

Wireless Telegraphy.—A correspondent says:—"Mr. A. Jennings, a young member of the local telegraph staff, has been lecturing at Port Elizabeth on wireless telegraphy, and exhibiting an apparatus of his own invention. In the course of the lecture messages were transmitted and received at the rate of 20 words a minute. Mr. Jennings has been working at his idea for three years, and his apparatus is said to be modelled on different ideas from that of Mr. Marconi."

CONTRACTS OPEN AND CLOSED.

OPEN.

Birkenhead.—June 9th. The Corporation wants tenders for one 225-kw. direct current high speed steam dynamo. See "Official Notices" May 19th.

Blackpool.—June 20th. The Corporation wants tenders for 6,000 tons of slack, 3,250 gallons of oil, and 138,000 carbons. See "Official Notices" June 2nd.

Canary Islands.—July 16th. Tenders are being invited until July 16th by the Spanish Post and Telegraph Authorities in Madrid for the concession for the establishment and working of a telephone system between Haria and Arrecife with three intermediate stations on the island of Lanzaroto, Canaries. Tenders to be sent to La Direccion General de Correos y Telegrafos, 10, Callede Carretas, Madrid, whence particulars may be obtained.

Dudley.—June 17th. The Electric Lighting Committee wants tenders for water-tube boilers, economiser, steam dynamos, balancers, switchboard, cables and street work, arc lamps, and travelling crane. See "Official Notices" May 19th.

France.—June 22nd. Tenders are being invited until the 22nd inst. by the French Post and Telegraph authorities in Paris for the supply of 510 tons of galvanised iron wire, 3 and 4 mm. diameter. Particulars may be obtained from, and tenders are to be sent to, Le Sous Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

Hackney.—June 13th. The Vestry invites tenders for trenching, troughing, cables, joint boxes, jointing and house services. See "Official Notices" May 5th.

Halifax.—The Watch Committee wants tenders for the wiring of the new Halifax Police Courts. See our "Official Notices" June 2nd.

Huddersfield.—June 12th. The Corporation invite tenders for the electric equipment of their present steam tram service, also for works to be executed, plant and machinery to be supplied, as follows:—Contract No. 1.—(Section A) engines and appurtenances, overhead travelling crane; (B) direct current generators, switchboard, station lighting, motors, cables, trolley poles, controllers, &c.; (C) cableways, overhead construction, trucks, and car bodies. Contract No. 2.—(D) steam boilers and accessories; (E) condensers, valves, heaters, pumps, &c.; (F) economiser, elevator and conveyor. Any contractor may tender for the whole or part of the work included in Contracts Nos. 1 and 2. Specifications on application to the Borough Engineer, 1, Peel Street, Huddersfield.

London, W.C.—June 13th. Tenders are wanted for carrying out an electrical installation at Mr. Wyndham's new theatre, Charing Cross Road. See our "Official Notices" June 2nd.

Spain.—June 25th. Tenders are being invited until June 25th by the municipal authorities of Alcala la Real (province of Jaen), for the concession for the electric lighting of the town during a period of three years. Particulars may be obtained from, and tenders to be sent to, El Secretario del Ayuntamiento de Alcala la Real (Jaen).

Teneriffe.—June 14th. Tenders are being invited until June 14th by the Spanish Ministry of Public Works in Madrid for the concession for the construction and working of an electric tramway between Santa Cruz de Teneriffe and San Cristobal de la Laguna, Teneriffe. Tenders to be sent to La Direccion General de Obras Publicas (Ministerio de Fomento), Madrid, whence particulars may also be obtained.

West Africa.—July 10th. The Compagnie de Mozambique, of 45, Rue do Alecrim, Lisbon, is inviting tenders until July 10th for the concession for the establishment and working of a central electric power station at Beira for lighting and power purposes during a period of 25 years. Particulars from, and tenders to, above.

CLOSED.

Brighton.—The Corporation has accepted the tender of Messrs. Fowler-Lancaster, Limited, for the supply of auxiliary switchboards and switchboard gallery at the electricity works, at £1,344 9s. The other tenderers, as given in the *Contract Journal*, were:—

	£	s.	d.
Nalder Bros. & Thompson, Limited	1,443	0	0
Laing, Wharton & Down, Limited	1,537	0	0
Siemens Bros. & Co., Limited	1,540	0	0
Crompton & Co., Limited	1,850	0	0

Hereford.—The Council has received the sanction of the Local Government Board to the £20,000 electric lighting loan, and has given the contract for iron roofing to Messrs. Alexander & Duncan, £394 odd, and for dynamos, engines, boilers, &c., to the India-Rubber Company, Silvertown, to be completed by October 1st. Fifty-four applications had been received for the post of clerk of works.

London.—The Shoreditch Vestry, at the meeting on Tuesday, considered the following tenders for the supply of a small direct current motor transformer for the meter testing room:—

Brush Electrical Engineering Company	£53
Electric Construction Company (without switch gear)	69
Mather & Platt	131
T. Parker, Limited	120
Siemens Bros. & Co.	176

The tender of the Brush Electrical Engineering Company was accepted.

Tenders as follows were received for laying the conduits required in connection with the new arc lighting extensions:—

British Insulated Wire Company	5s. 8d. per yard.
W. Griffiths	6s. 0d. „

The offer of the British Insulated Wire Company was accepted.

The following firms tendered for the supply of machinery required for the new workshop:—Messrs. Aublet, Harry & Co., Archdale & Co., Buck & Hickman, and Moser & Co. On the advice of the chief engineer the Vestry accepted the tender of Messrs. Archdale & Co. as follows:—One 6-inch back gear lathe, self-acting, screw cutting, £60; one sensitive drilling machine, to drill up to ⅝ inch, £20; and one double gear drilling machine, to drill up to 1¼ inch, £37.

Manchester.—The Electricity Committee have accepted the tender of the Westinghouse Electric Company, Limited, for the supply and erection at the Bloom Street generating station of four 1,800-kw. combined engine and dynamo machines.

Peterborough.—At the Town Council on Friday last the following tenders were accepted for plant in connection with the proposed electric light works:—

Boilers and economisers: E. Danks & Co.	£1,650
Willans engines: The General Electric Company, Manchester	1,952
Battery: Prichetts & Gold (and £55 maintenance)	849
Switchboard: Crompton & Co.	634
Piping: Ashton, Frost & Co., Blackburn	1,700
Cables: Callender's Cable and Construction Company	3,961

An amendment was proposed to the tender of Messrs. E. Danks and Co. by Councillor Reseley, and seconded by Mr. G. Keeble, on the ground that the firm did not pay the recognised standard rate of wages.

Reigate.—The *Contract Journal* gives the following list of tenders received and accepted for the supply and erection of plant for the Town Council: (Contract No. 1) two water-tube boilers, economiser, brickwork and flues; (2) steam, exhaust and other pipes, steam pumps, &c.; (3) two 100-kw. and one 30-kw. steam alternator, 8-ton overhead travelling crane, and sub-stations' equipment; (4) switchboard and instruments; (5) mains, lamp-posts, lamps and fittings:—

CONTRACT No. 1.

	£	s.	d.
R. Hornsby & Sons, Limited	2,476	10	0
Babcock & Wilcox, Limited (accepted)	2,118	0	0
Stirling Boiler Company	1,980	0	0
D. Stewart & Co.	1,938	0	0

Alternative tenders.

Babcock & Wilcox, Limited	2,042	0	0
„ „ „	1,921	0	0

CONTRACT No. 2.

	£	s.	d.
G. Wailes & Co.	1,760	10	0
J. Spencer, Limited	1,730	0	0
Babcock & Wilcox, Limited (accepted)	1,679	0	0

CONTRACT No. 3.

	£	s.	d.
S. Z. de Ferranti, Limited	5,727	3	0
British Thomson-Houston Company, Limited	5,352	0	0
J. Fowler & Co., Limited	5,277	0	0
British Schuckert Company, Limited	5,094	0	0
Bertram Thomas	4,978	0	0
Brush Company, Limited	4,820	13	6
Crompton & Co., Limited	4,779	0	0
W. H. Allen & Co., Limited	4,717	0	0
Electric Construction Company, Limited (accepted)	4,602	0	0
Rosling & Appleby	4,499	0	0
Johnson & Phillips	4,465	0	0
Mather & Platt, Limited	4,451	0	0

Alternative tenders.

S. Z. de Ferranti, Limited	5,210	10	0
Bertram Thomas	5,278	0	0
W. H. Allen & Co., Limited	4,881	0	0
„ „ „	4,813	0	0
Electric Construction Company, Limited	4,698	0	0
„ „	4,903	0	0
Johnson & Phillips	4,747	0	0
Mather & Platt, Limited	4,690	10	0
„ „	4,674	10	0

CONTRACT No. 4.

	£	s.	d.
Fowler-Lancaster, Limited (approximate tender only)	1,150	0	0
J. Fowler & Co., Limited	926	0	0
North Wilts Company, Limited	913	7	0
S. Z. de Ferranti, Limited	862	15	0
Bertram Thomas	732	9	6
Johnson & Phillips	699	0	0
Edison & Swan	689	0	0
General Electric Company, Limited	624	10	0
Cowans, Limited (accepted, with extra bar)	674	0	0
Crompton & Co., Limited	546	0	0
British Schuckert Company, Limited	500	0	0
Veritys, Limited	454	10	6
Dobsons & Curtis Bros., Limited	426	15	2
„ „	896	15	2

CONTRACT No. 5

	£	s.	d.
Bertram Thomas	10,356	15	2
Henley's, Limited	9,643	11	5
Crompton & Co., Limited	9,577	3	9
W. T. Glover & Co., Limited	9,378	6	0
General Electric Company, Limited	9,164	15	6
Johnson & Phillips (one item approximate estimate)	9,062	12	8
Callender's Cable and Construction Company, Limited (accepted)	8,767	13	7
British Insulated Wire Company, Limited	8,516	4	5

Mr. F. H. Medhurst is the consulting engineer.

FORTHCOMING EVENTS.

Friday, June 9th.—At 6.30 p.m. The Institution of Junior Engineers. Visit to the Bankside Works of the City of London Electric Lighting Company.

Institution of Civil Engineers' Conference. (Continued.)

At 5 p.m. Physical Society, rooms of the Chemical Society, Burlington House. Agenda:—1. "On the Distribution of Magnetic Induction in a Long Iron Bar," by Mr. C. G. Lamb; 2 "On the Absolute Value of the Freezing Point," by Mr. J. Rose-Innes.

Monday, June 12th.—At 8 p.m. Röntgen Society. General Meeting at 11, Chandos Street, Cavendish Square, W. Portable Röntgen apparatus, for field and ward work, will be demonstrated and described by Major Beevor, R.A.M.C, J. Hall Edwards, Esq., and Mr. H. W. Cox; a new Stereoscope will be demonstrated for Mr. Gregory, by F. W. Watson Baker, Esq.; Dr. Walsh will also show a new Stereoscope.

Wednesday, June 14th (also 15th, 16th, and 17th). Convention of the Municipal Electrical Association at Bristol.

NOTES.

The Wehnelt Interruptor.—Mr. Harry W. Cox, the well-known maker of induction coils, read a paper before the Röntgen Society on May 30th, in which he described some important discoveries he had made in connection with the practical working of the Wehnelt interruptor in Röntgen ray work. The great intensity of the discharge produced with the Wehnelt interruptor has its drawback in the fact that the X ray tubes hitherto used will not stand for any length of time. Mr. Cox has found that this nuisance is considerably abated by using tubes of moderately low vacuum. They do not give quite such a brilliant production of X rays, but they give excellent results and last longer. Such tubes can be worked from 10 to 20 minutes continuously. Tubes with large bulbs run longer than those with small bulbs. With a 50-volt accumulator and the Wehnelt interruptor, little or no resistance need be inserted in the circuit, but with 100 volts a variable resistance is necessary. Mr. Cox also found that with two interruptors connected in series in 100-volt circuit, the tubes run more evenly than when working with one. One specially valuable property of the Wehnelt interruptor is that there is no risk of burning up the coil, since the current is less when it stops than when it is working. Mr. Cox found with a working current of 7 or 8 amperes there was only 1 ampere when the interruptor stopped; with two interruptors in series the reduction was still greater. The liability of the interruptor to stop is reduced by putting an inductance in circuit. When the active electrode of the interruptor was some distance from the cathode, it worked better than when quite close. The circulation of the liquid, according to Mr. Cox's experience, did not improve the working. He points out the danger of explosion, which arises from confining the gases in the cell by a lid. The following are comparative times of exposure required with the mechanical break and the Wehnelt interruptor:—

	Mechanical break.	Wehnelt interruptor.
Thigh, knee ...	3 to 8 minutes. ...	60 to 130 seconds.
Chest	5½ to 15 „ ...	1½ to 2 minutes.
Pelvis	8 to 15 „ ...	2 to 3 „

Institution of Electrical Engineers.—The following are the words of the address offered to Her Majesty on the occasion of her 80th birthday by the Institution of Electrical Engineers:—

To the Queen's Most Excellent Majesty.

May it please Your Majesty:—We, Your Majesty's loyal and faithful subjects, the President, past-Presidents, Vice-Presidents, Council, and Members of the Institution of Electrical Engineers, desire humbly to offer to Your Majesty our heartfelt congratulation on the completion of the 80th year of Your Majesty's great and glorious life, and we earnestly pray that Your Majesty may long be preserved to reign over these realms, which for 62 years have been blessed under Your Majesty's beneficent sway.

(Signed) J. Wilson Swan, President 1898-1899.
Silvanus P. Thompson, President 1899-1900.
Walter G. McMillan, *Secretary*.

Utilising the Tides.—We read that the Southend Corporation has had a Utopian scheme brought before it by a London capitalist for constructing a huge sluice sea wall, at a cost of £600,000, with a view to utilising the tidal forces in connection with an electricity supply scheme for the town. The Southend Council should peruse our last week's article on "Wave Motors" before going too deeply into this proposal. We believe the great problem at Southend hitherto has been how to get rid of the mud, so that the visitors might see a little more of the sea, which the present inventor wishes to take advantage of. The point, therefore, which will appeal to the mind of the Council is the intention of the schemer to keep the mud continuously covered by water 3 feet 6 inches deep.

The Birthday Honours.—In the list of Birthday Honours we note that the Queen has been pleased to confer the dignity of a baronetcy upon Prof. J. S. Burdon Sanderson, while Mr. W. H. Preece, C.B., and Prof. Michael Foster are both promoted to K.C.B. Mr. Preece's brother (Mr. J. R. Preece), the Telegraph Engineer and British Consul at Ispahan, has received a C.M.G.

Hughes on Ether Telegraphy.—Mr. Munro writes to say that in the course of his experiments on ether telegraphy (see ante p. 883), Prof. Hughes made an observation which has a philosophical interest. He found that the local battery in the receiving circuit should be very feeble. One cell having its electromotive force reduced by resistance to $\frac{1}{50}$ volt was enough, and more was likely to break down the high resistance of contact in the microphone. With a microphone in the form of a ladder of needles (two parallel needles with others laid across them) in circuit with the cell reduced to $\frac{1}{30}$ volt and a telephone, there was no apparent contact between the needles permitting a current in the telephone, not even with 40 or more needles across. In fact, he has placed a pound weight on one of the cross needles without causing a current in the telephone. Nevertheless, such a microphone was quite sensitive to the ether waves. On increasing the battery to $\frac{1}{25}$ volt contact between the needles was perfect and remained so until disturbed.

Observatories and Electric Tramway Currents.—In his report on the year's work at Greenwich Observatory, the Astronomer Royal has the following regarding the effect of electric tramway and railway currents upon magnetic observatories:—"The question of the protection of the Observatory from disturbance of the magnetic registers by electric railways or tramways in the neighbourhood has caused much anxiety during the past year. A number of such railways are now projected, and the value of the magnetic registers, which have now been carried on continuously for nearly 60 years, will depend entirely on the conditions under which electric traction is used. Steps have been taken, in concert with Prof. Rücker, acting on behalf of Kew Observatory, to have a special clause inserted for the protection of Greenwich and Kew Observatories. This has already been accepted in several cases, and it is hoped that it will be agreed to in others where necessary."

Sir George Stokes's Jubilee.—On 2nd inst. the world of science assembled at Cambridge to do honour to Sir George Gabriel Stokes on the occasion of his jubilee as Lucasian Professor of Mathematics. Representatives of the learned societies in all parts of the world were among the distinguished company. In the various addresses presented the highest tributes were paid to Sir George's distinguished service in the pursuit of science. Lord Kelvin presented addresses from three bodies, and Lord Lister read that sent by the Royal Society. A gold medal was presented to this veteran of science by the Chancellor in the name of the University, and on behalf of the Physical Section of the French Institute a medal was handed to him by Prof. Cornu.

Sterilisation of Water.—Mr. E. Andreoli writes that since April 14th he has realised some important progress in the sterilisation of water by ozone. In his article, which appeared in the Electrical Review on May 5th, he stated that the electrical energy spent in the sterilisation of 1 cubic metre of water (220 gallons) was about 130 watt-hours. In the experiments he has since made he has found a slight improvement in his installation which enables him to sterilise the same quantity of water with 60 to 70 watt-hours, roughly, 3,000 gallons of water per kilowatt-hour.

Royal Institution Centenary.—A centenary banquet was held on June 5th in the Merchant Taylors' Hall, at which the chair was taken by the Duke of Northumberland (president). Among those present were the Prince of Wales, the Duke of Cambridge, Lord Rayleigh, Lord Kelvin, and a large body of distinguished gentlemen. In proposing the loyal toasts, the chairman referred to the first visit of H.R.H. the Prince of Wales to the Royal Institution in 1855, when Faraday was the lecturer. In reply, his Royal Highness briefly outlined the history of the Institution, which was founded by Count Rumford, and referred to the discoveries of Faraday, Lord Rayleigh, Davy, and other great scientists. The meeting concluded with the usual complimentary toasts. A general meeting of the members of the Royal Institution was held on June 5th, when amongst other acknowledgments the members' thanks were returned to Mr. H. Spottiswoode for the gift of his father's collection of physical apparatus.

Appointments Vacant.—The Doncaster Corporation wants an electrical clerk of works who might ultimately be appointed resident electrical engineer. See "Official Notices" this week.

The Wallasey District Council want applications for the appointment of a junior electrical engineer at £130 per annum. See our "Official Notices."

The British Continental Electricity Company want an assistant electrical engineer at £110 per annum for their San Remo generating station. See our "Official Notices" this week.

The Birmingham Corporation want a lecturer and demonstator in electrical engineering and allied subjects at £125 per annum. The Sheffield Tramways Committee want an assistant electrical engineer at £200 (rising to £250) per annum. The Newington Vestry want an accountant to take charge of the electricity accounts at £155 (rising to £200) per annum. The British Electric Traction Company are also wanting a gentleman to assist in the managerial department. For particulars of these appointments see our "Official Notices."

Action for Infringement.—At the meeting of the Croydon County Council on Monday, the Finance Committee reported that an action had been commenced against the Corporation by the Jandus Arc Lamp and Electric Company, Limited, for alleged infringements of letters patent in connection with the use of the Davy enclosed arc lamp. The town clerk was directed to defend the action.

Lectures.—Mr. James Swinburne, Vice-President of the Institution of Electrical Engineers, is now giving a course of lectures on "Dynamo and Transformer Construction" to the students of the Electrical Standardising, Testing and Training Institution.

Presentations.—On the occasion of his approaching marriage, Mr. Wm. W. Lackie, chief assistant engineer at the Glasgow Corporation electricity works, was last week entertained to dinner by the staff of the department, they having some days previously presented him with a gold watch and chain, and a diamond and sapphire ring for his bride.

At Wolverhampton last week the North Midland district staff of the National Telephone Company presented Mr. Wm. Johnston, A.M.I.E.E., the late manager of that district, with a valuable portmanteau, a camera, and an address, on the occasion of his leaving to take up an appointment in South America.

Old Students' Dinner.—The second annual dinner of the Association of Old Students of the Central Technical College will be held on Thursday, July 6th, at Frascati's Restaurant, Oxford Street. Any old students desiring to be present can obtain full particulars by applying to Mr. F. S. Miller at the College, South Kensington.

An Imperial Telegraph System.—A correspondent sends us the following:—"Writing in the *Nineteenth Century*, Mr. Henniker Heaton strongly advocates the reduction of the charges at present made for telegrams to India and the Colonies, to be effected principally by a well-organised landline service. To a considerable extent I am in agreement with the views expressed. It seems absurd that a telegram can be sent from London to Constantinople for 6½d. per word, while the charge to India, about double the distance, is 4*s.* for each word. Mr. Henniker Heaton concludes his characteristic article with a reference to 'the beneficent genius of electricity, now bound and writhing under the spell of a too masterful magician—the monopolist—who has hitherto persuaded the people that electricity can only be generated in Old Broad Street, in the City of London.'"

Competition to be Allowed in the City.—As we go to press we hear unofficially that Sir Courtenay Boyle recommends that the Charing Cross and Strand Electricity Supply Company be allowed to supply current in the City district in competition with the City Company. The Court of Common Council had a lengthy discussion on the matter yesterday afternoon.

Electrical Engineers at Cape Town.—We read in a South African journal that a section of the Institution of Electrical Engineers has been formed at Cape Town with Mr. J. Proctor Banham, of the Harbour Board electrical works, as president, and Mr. Denham, of the railway department, as honorary secretary.

The Accumulator as Incubator.—That an "incubator" is an essential part of an efficient electric light plant, is the gospel of electric lighting according to a member of a place of worship in the fair Vale of Conway, and as the Electric Light Company has not put down an "incubator," then it would be better to defer the question of lighting the church electrically for the time being. We will be charitable enough to assume that this was purely a case of *lapsus linguæ*, or else imagine that the speaker was not used to the steep gradients and sudden curves of the Welsh dialect. Obviously, "accumulator" was meant, but as the speaker was a leading man of the town and professed to possess knowledge of the subject, we suppose no one presumed to contradict him, although the local press had a little smile all to itself. Someone suggests that the speaker was confused with that statement, whose frequency is very high, that electricity is in its infancy. But we rather fancy that electricity passed its incubator stage before that convenient invention made its appearance.

The French Automobile Club.—The *Times* correspondent says that the Automobile Club is to be closed, the attack on M. Loubet having, it is believed, been organised there.

Appointment.—Mr. W. P. Bloxam, superintendent of the Dover Electrical Supply Company, has been appointed assistant electrical engineer at the Belfast electricity works in succession to Mr. Olssen, resigned.

Erratum.—In our last issue, p. 918, 2nd column, 6th line, for "tried" read "triad."

NEW COMPANIES REGISTERED.

Weston-super-Mare and District Electric Supply Company, Limited (62,306).—This company was registered on May 26th, with a capital of £50,000 in £10 shares, to carry on the business of electrical engineers, electricians, engineers and contractors, suppliers of electricity, manufacturers of electrical apparatus, tramway and light railway proprietors, carriers of passengers and goods, &c. The first subscribers (each with one share) are:—G. J. Somerville, 35, Shepherd's Bush Road, W., electrical engineer; E. Hopwood, 35A, Hertford Street, Mayfair, W., clerk; C. Walmsley, 28, Priory Road, Kew, accountant; H. S. Morrison, 102, Constantine Road, Hampstead, N.W., solicitor; J. Renwick, 29, Hillside Road, Stamford Hill, N., clerk; M. H. Sheerboom, 6, Ferncliff Road, London, N.E., clerk; W. E. Singleton, St. Edmund's Terrace, Regent's Park, N.W., solicitor. The number of directors is not to be less than three nor more than five; the first are to be appointed by the subscribers; qualification, £100; remuneration as fixed by the company. Registered office, Victoria Embankment, London.

La Capital Traction and Electric Company, Buenos Ayres, Limited (62,311).—This company was registered on May 27th, with a capital of £1,200,000 in £5 shares (120,000 preference), to acquire the benefit of any concessions granted or to be granted by any authority in the Argentine Republic, to construct and equip tramways and railways, to work the same by horse-power, electricity, steam, or otherwise, and to carry on in the Argentine Republic or elsewhere the business of suppliers of electricity for the purposes of light, heat, and power, electricians, electrical and mechanical engineers, and manufacturers of electrical apparatus. The first subscribers (each with one share) are:—Fortescue Thursby, 10, Draper's Gardens, E.C., solicitor; George H. Short, 13, Cross Street, Hatton Garden, assistant manager; T. Hinks, 4, Bennett Park, Blackheath, S.E., secretary; John M. Bartlett, 62, St. Alban's Road, Seven Kings, Ilford, E., clerk; Curt Nanwerck, 13, Dalrymple Road, Brockley, S.E., gentleman; Archibald E. Ford, 65, Burton Road, Brixton, S.W., gentleman; and Percy Barker, 55, Lausanne Road, Hornsey, clerk. Registered without articles of associa ion.

Witney Syndicate, Limited (62,320).—This company was registered on May 29th, with a capital of £1,000 in £10 shares, to promote a company to carry on at Witney, in the county of Oxfordshire, and elsewhere, the business of an electric light company, and to carry on the business of electricians, electrical and mechanical engineers, suppliers of electricity, and manufacturers of electrical apparatus, &c. The first subscribers (each with one share) are:—Arthur Musker, Dundas Street, Bootle, engineer; Anthony Barrell, Market Place, Witney, draper; Edmund L. Hill, Dundas Street, Bootle, engineer; John E. Elliott, 13, Magdalen Street, Oxford, engineer; William T. Upton, 13, Magdalen Street, Oxford, engineer; Charles E. Gillett, 86, Woodstock Road, Oxford, banker; and Joseph Bartlett, 71, High Street, Witney, builder. The first manager or managers are to be appointed by the subscribers; remuneration as fixed by the company.

Witney Electric Supply Company, Limited (62,336).—This company was registered on May 30th, with a capital of £10,000 in £1 shares, to adopt agreements (1) with the Witney Syndicate, Limited, and (2) with C. A. Musker, Limited, and to carry on at Witney, Oxfordshire, and elsewhere, the business of suppliers of electricity for the purposes of light, heat, motive power, and otherwise; electricians, electrical and mechanical engineers, manufacturers of and dealers in electrical apparatus, &c. The first subscribers (each with one share) are:—Arthur Musker, Dundas Street, Bootle, engineer; Anthony Barrell, Market Place, Witney, draper; Joseph Bartlett, 71, High Street, Witney, builder; Edmund S Hill, Dundas Street, Bootle, engineer; John E. Elliott, 13, Magdalen Street, Oxford, engineer; William T. Upton, 13, Magdalen Street, Oxford, engineer; and William C. Bartlett, 75, High Street, Witney, builder. The number of directors is not to be less than three nor more than five; the first are J. Bartlett, A. Barrell, and Edmund S. Hill; qualification, £200; remuneration as fixed by the company.

Lloyd Manufacturing Company, Limited (62,374).—This company was registered on May 31st, with a capital of £20,000 in £10 shares, to acquire certain patent and other rights from Marshall B. Lloyd, to acquire all or part of the share capital of the White Manufacturing Company, Limited, of Minneapolis, U.S.A., and to carry on the business of wire manufacturers and workers, spring makers, electrical and general engineers, &c. The first subscribers (each with one share) are:—Marshall B. Lloyd, Nicollet Island, Minneapolis, U.S.A., wire goods manufacturer; Rowland Siddall, West Royd, Sowerby Bridge, spring mattress manufacturer; Mrs. Miranda Siddall, West Royd, Sowerby Bridge; Arthur Siddall, The Mount, Sowerby Bridge, worsted spinner; William H. Armitage, 23, John William Street, Huddersfield, chartered accountant; William Rumsden, Westgate, Huddersfield, solicitor; and Richard V. Rigby, Market Place, Huddersfield, bank manager. The first directors (to number not less than two nor more than seven) are Marshall B. Lloyd and Rowland Siddall; qualification, 50 shares; remuneration as the company may decide.

Elmore's Trust, Limited (62,380).—This company was registered on May 31st, with a capital of £400,000 in £1 shares, to acquire the business of Elmore's Patent Copper Depositing Company, Limited; Elmore's Wire Manufacturing Company, Limited; Elmore's American and Canadian Patent Copper Depositing Company, Limited; and Elmore's Foreign and Colonial Patent Copper Depositing Company, Limited, or any of them, to adopt agreements with the said companies, and to sell the property acquired thereunder to the English Electro Metallurgical Company, Limited. The first subscribers (each with one share) are:—William Dunn, 31, Abchurch Lane, E.C., solicitor; G. V. Schmettau, 91, Croxted Road, West Dulwich, S.E., law student; C. W. Longman, 181, Leathwaite Road, Clapham Common, S.W., gentleman; W. Boyes, 2, Carpenter Villas, Hill Street, Peckham, S.E., gentleman; Alfred H. Wynne, "The Nook," Southend-on-Sea, accountant; H. Mason, Finden Cottage, Dulwich Village, S.E., gentleman; and Wallace Read, 190, Friern Road, East Dulwich, solicitor. The number of directors is not to be less than three nor more than eight; the subscribers are to appoint the first; qualification, 250 shares; remuneration, £100 each per annum, and £150 for the chairman.

United Kingdom Tramway, Light Railway, and Electrical Syndicate, Limited (62,387).—This company was registered on June 1st, with a capital of £20,000 in £1 shares, to acquire, construct, own, and work any light railways, tramways, &c., to manufacture and deal in motor cars and motors, and to carry on the business of electricians, electrical and mechanical engineers, suppliers of electricity for the purposes of light, heat, and power, &c. The first subscribers (each with one share) are:—John H. Allison, 7, Courtney Road, Drayton Park, N., secretary; Thomas L. Nottage, 4, Farron Road, Clapton, N.E., clerk; Harry Leonard, 17, Bernard Street, W.C., solicitor; Francis B. F. Millard, 7, Lysander Grove, Upper Holloway, N., clerk; Walter H. Lawley, 78, Grange Park Road, Leyton, E., clerk; Harold S. Spashett, Ivy Lodge, Ilford, Essex, clerk; and Hugh S. Munns, 8, Old Jewry, E.C., solicitor. The first directors (to number not less than two nor more than five) are Major Hector Tullock, R.E., C.B., William E. Kenway, and Samuel R. Blundstone; qualification, £100; remuneration, two guineas each per board meeting attended.

Leeds Electrical Supply Company, Limited (62,293).—This company was registered on May 26th, with a capital of £2,000 in £1 shares, to acquire the business carried on by Clarence M. Stead at Merrion Street, Leeds, as the Electrical Supply Company, and to carry on the business of electrical engineers, fitters, machinists, manufacturers of and dealers in electrical, gas, oil, water and other motors, suppliers of electricity, &c. The first subscribers (each with one share) are:—Clarence M. Stead, 9, Gusneau View, Leeds, electrical engineer; James E. Brooke, 4, Grosvenor Crescent, Leeds, photographer; William O. Guest, 56, Leicester Grove, Leeds, cashier; Henry Hamer, 28, Green Mount Street, Leeds, stationer; Thomas R. Martin, Albert Terrace, Middlesbrough, electrical engineer; John C. McCandlish, 115, Woodhouse Lane, Leeds, surgeon; John S. Thorp, 70, Trinity Street, Huddersfield, engineer. Registered without articles of association. Registered office, 48, Merrion Street, Leeds.

Birmingham and North-West Coast Mutoscope Company, Limited (62,295).—This company was registered on May 26th, with a capital of £40,000 in £1 shares, to acquire the business of the Birmingham Mutoscope Company, Limited, the North Wales Mutoscope Company, Limited, and the Blackpool and Southport Mutoscope Company, Limited, to manufacture, let on hire, and deal in mutoscopes, biographs and mutographs, and to carry on the business of electricians, electrical and mechanical engineers, &c. The first subscribers (each with one share) are:—James Adie, 337, Hagley Road, Birmingham, gentleman; L. J. Murray, Vesta House, Lodge Road, Birmingham, glass manufacturer; William S. Aston, 7, Newhall Street, Birmingham, chartered accountant; Thomas H. Vale, Heathfield Road, Handsworth, Birmingham, clerk; E. A. Smith, 6, Lozells Street, Lozells, Birmingham, clerk; J. H. Clarkson, Fox Hollies Road, Acocks Green, Worcestershire, clerk; and W. H. Clement, 30, Heathfield Road, Handsworth, Birmingham, clerk. The number of directors is not to be less than two nor more than seven; the first are Walter Harley, James Adie, Lewis J. Murray, and William T. Smedley; qualification, 250 shares. The British Mutoscope and Biograph Company, Limited, have certain rights of nominating directors.

CITY NOTES.

The Joel Electric Carriage-Motor and Battery Syndicate, Limited.

The prospectus of this syndicate is obtainable, and applications must be received on or before Saturday, June 17th, 1899. The capital is to be £50,000, divided into 25,000 preference and 25,000 ordinary shares of £1 each.

The vendors are another syndicate entitled the National Motor Carriage Syndicate, Limited, and the amount this syndicate agrees to accept for the sale of various patent rights and whole of its assets, consisting of three fully-equipped electric carriages, working drawings, plans, and registered designs, is £30,000—in fully paid ordinary shares £22,500, and the balance of £7,500 in cash. The new syndicate also undertakes to discharge the liabilities of the old syndicate, which are guaranteed not to exceed £1,500.

There is much that is conjectural and much to which exception might be made in the statements put forth, but we cannot at the moment go as fully into the matter as we should like. Anyone desiring to invest in this undertaking should remember that it is of an exceedingly speculative kind, and that mere estimates of profits, &c., in such matters are of but little value.

The Telegraph Manufacturing Company, Limited.

The directors' report and accounts to be submitted to the ordinary general meeting at the Law Association Rooms, Cook Street, Liverpool, to-day, Friday, at 3 p.m., says:—The directors beg to submit to the shareholders their first annual report, accompanied by balance-sheet and profit and loss account for the year ending March 31st, 1899. The profit on the year's working, as shown by the profit and loss account, is £28,271 9s. 10d. Out of this sum the managing director's salary and directors' fees, £1,200, and the preference dividend, due April 1st, £2,927 1s. 10d., have been paid, and after placing to depreciation account £3,140, to reserve fund £10,000 (which includes the proportion of profits earned from March 31st, 1898, up to the date of the formation of the company), and to a special insurance fund £1,000, there remains a balance of £10,004 8s., which the directors recommend shall be dealt with as follows:—In payment of a dividend of 6 per cent. and a bonus of 2 per cent., both free of income-tax, for the period during which the capital of the company has been paid up, being in all at the rate of 8 per cent. per annum, and that the balance, £5,161 15s. 3d., be carried forward. The directors deeply regret that shortly after the allotment of shares they were deprived, owing to a sad accident, of the invaluable services of Dr. John Hopkinson, but they are pleased to state that to fill the vacancy thus caused they have secured the services on the board of Mr. J. S. Harmood Banner, whose name will be well known to the majority of the shareholders. During the period under notice the works have been fully employed, and extensions are in progress to meet the increased demand for the company's manufactures. The auditors, Messrs. Harmood Banner & Son, retire, and offer themselves for re-election.

New General Traction Company, Limited.—This company, having an authorised capital of £370,000 in shares of £5 each, of which 54,000 have already been issued, is now issuing the remaining capital of 20,000 6 per cent. cumulative preference shares

at a premium of 5s. per share. In addition to the Coventry and the Douglas Southern Electric Tramways, already built and equipped, the company has powers for extension of the lines in the City of Coventry and for the installation of tramways at Norwich, both of which undertakings are approaching completion. It is worthy of note also that the company has taken over an agreement for a tramway enterprise in the United States of America—carrying the war into the enemy's country! The list opened on Monday, June 5th, and was closed on Tuesday, June 6th.

The Electric and General Investment Company, Limited.—Subject to the completion of the audit, the directors have decided to recommend the payment of the following dividends, &c., for the year ended May 31st, 1899:—

Ordinary Shares.—A dividend of 5s. per share, of which 2s. per share was paid on account in December last, leaving	3s. per share to be distributed
A bonus of	4s. per share
The trustees for the ordinary shares reserve fund propose to distribute out of the proceeds of investments sold and dividends received ...	2s. „
Making a total present distribution of	9s. „
Founders' Shares.—A dividend for the year ended May 31st, 1899, of	£30 per share
A bonus of	40 „
The trustees for the founders' shares reserve fund propose to distribute out of the proceeds of investments sold and dividends received ...	20 „
Making a total present distribution of	£90 „

The dividends, if sanctioned by the shareholders, will be paid on June 27th, 1899.

Birmingham Electric Supply Company.—An extraordinary general meeting of this company was held on 1st inst. at the company's offices, Dale End, to approve a Bill introduced into the House of Lords for the purpose of carrying into effect the terms of the sale of the company's undertaking to the Birmingham Corporation, as stated in the agreement dated June 10th last year. Mr. H. Buckley presided, and said the meeting was called simply in compliance with the Standing Orders of the House of Lords. The Bill for the purpose of putting in force the agreement with the Corporation for the sale of the company's undertaking had passed the House of Commons, and by one of the Standing Orders of the House of Lords it was necessary to call a meeting of the shareholders to approve of the Bill before it could pass that House. He proposed that the Bill be approved. The resolution was carried.

Callender's Cable and Construction Company, Limited.—At the annual meeting to be held on June 22nd, 1899, the directors of this company will recommend that the dividend for 1898 be at the rate of 10 per cent. per annum (of which 5s. per share has been paid as interim dividend); that a further sum of 5s. per share be paid as bonus, making, with the dividend, a total distribution for the year at the rate of 15 per cent.; that £15,000 be placed at reserve; that £5,000 be written off property account, and that the balance of nearly £7,000 be carried forward.

Brazilian Submarine Telegraph Company, Limited.—The directors have declared an interim dividend of 3s. per share, or at the rate of 6 per cent. per annum, free of income-tax, for the quarter ended March 31st, 1899, and payable on 23rd inst. The transfer books will be closed from June 16th to 22nd, both days inclusive.

Commercial Cable Company.—A quarterly dividend of 1¾ per cent. is payable on July 1st.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending June 3rd, 1899, were £887 6s. 5d.; aggregate to date, £7,370 18s. 11d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending June 2nd, 1899, were £3,055 7s. 7d.: corresponding period (Whit week), 1898, £3,717 3s.; decrease, £661 15s. 5d.

The Cape Electric Tramways.—The receipts for May were:—Cape Town, £9,000; Port Elizabeth, £2,300.

The City and South London Railway Company.—The receipts for the week ending June 4th, 1899, were £960; week ending June 5th, 1898, £949; increase, £11; total receipts for half-year, 1899, £24,230; corresponding period, 1898, £23,627; increase, £603. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending June 3rd, 1899, were £186 7s. 11d.; week ending June 4th, 1898, £184 10s. 10d.; increase, £1 17s. 1d. Total receipts to date, 1899, £3,446 16s. 6d.; corresponding period, 1898, £2,676 17s.; increase, £769 19s. 6d. Miles of track open week ending June 3rd, 1899, 8; week ending June 4th, 1898, 8. Car miles run week ending June 3rd, 1899, 8,233; week ending June 4th, 1898, 8,334. Number of cars, week ending June 3rd, 1899, 11; week ending June 4th, 1898, 7.

The Dublin United Tramways Company.—The receipts for the week ending Friday, June 2nd, 1899, were as follows:—D. U. T. Co., horse cars, £2,095 10s. 8d.; ditto, electric cars, £1,277 18s. 9d.; D. S. D. Co., electric cars, £982 11s. 1d.; total, £4,356 0s. 6d.; corresponding week last year—D. U. T. Co., horse cars, £2 951 15s. 3d.; ditto, electric cars, £596 6s. 6d.; D. S. D. Co., electric cars, £808 0s. 10d.: total, £4,356 2s. 7d.; decrease, 2s. 1d.; aggregate to date, £76,741 16s. 1d.; ditto last year, £72,608 17s. 8d.; increase to date, £4,132 18s. 5d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 11 miles electrically, and 31 miles by horses, for the corresponding period last year.

The Hobart Electric Tramway.—The receipts for April show an increase of £110.

The Liverpool Overhead Railway Company.—The receipts for the week ending June 4th, 1899, amounted to £1,478: corresponding week last year £1,869; decrease, £391. 1898 includes Whit Monday.

The Mexico Electric Tramways.—The receipts of the Mexico Electric Tramways (May) were £16,765.

The South Staffordshire Tramways Company.—The receipts for week ending June 2nd, 1899, were £619 3s. 5d.; aggregate receipts for 22 weeks £13,884 2s. 1d.; week ending June 3rd, 1898, £869 17s. 6d.; aggregate receipts for 22 weeks, £13,315 15s. 6d.

STOCKS AND SHARES.

Wednesday Evening.

WITH the Stock Exchange thermometer standing at 75° in the shade for the greater part of the week, it is not very astonishing that business should have dulled down in most departments of the house, and that the Electric Lighting and Traction markets are merely in accord with others in their quietude.

There is scarcely a change to record among Electric Lighting shares. Little or nothing has been doing in any of them with the exception of City of London and House-to-House. Considerable interest centred round the meeting of the Common Council on Thursday, June 8th, and speculation has been rife as to its probable outcome. In the interim, the shares were quietly bought, and the price went over 18 at one time, then swiftly descended to 16. With regard to House-to-House shares, the quotation has dropped 10s. upon those pertinacious sales that have lately been troubling the market, for no support is given, and the price crumbles away almost at the look of a possible seller. The shares can now be bought to yield an investor 6¼ per cent. on his money, but the market is not a good one. Notting Hills are unable to recover the fraction which they recently shed; they are, however, steady at 16½.

Electric tramways descriptions are receiving some little consideration, their supporters pointing to the rapidly increasing favour which this system of haulage is finding throughout the United Kingdom. It is rather singular that there should not be a London quotation for the shares of that company which has done so much to bring electric traction before the notice of the metropolis. The London United Tramways shares are unknown in the Stock Exchange here, but there is an official price for Imperial Trams, and from Bristol advices we learn that this latter company owns nearly all of the capital of the Hammersmith line. Imperial Tramway Shares, £6 each, fully paid, are 24½ to 25½, the market being mostly in Bristol, and for a "lock-up" they are worth buying.

Dealings in Bordeaux Trams have practically ceased pending the re-arrangement, but Buenos Ayres and Belgrano are a lively market, and it is whispered that important developments are pending in connection with this company. Anglo-Argentines are the turn easier at 4⅛. Other Traction Securities are steady, and both the British Electric Preference issues have risen a half, although the Ordinary shares mark no alteration. In this department we consider that Potteries Electric Traction shares at 15 are worth watching. New General Tractions are ¼ better at 4, and the new issue of Preference shares, which we announced last week, has been moderately applied for. The whole of it was, of course, underwritten before the emission. By applying for the new shares, there was a saving of 5s. each as compared with bringing the existing issue in the market, to say nothing of the escape from stamp duty and broker's charges.

New Companies are making their appearance every day in order to get out before the "close time" of the summer holidays, and the provinces are supplying their full quota of novelties. Weston-super-Mare is represented in the latest lists with an Electric Supply proposition, but we understand that this will not be brought as far as London. A much larger concern than either of these is the La Capital Traction and Electric Company of Buenos Ayres, whose capital of £1,200,000 we believe will shortly be offered for public subscription.

Telegraph stocks and shares are inclined to dulness, there being no particular demand at the moment for this class of investment. Direct United States Cable are an exception, and have risen 5s. to 11⅝. Eastern Extension 4 per cent. Debenture fell 3 points to 120, but picked up again to 122, and Indo-European Ordinary at 54½ is 1 down. West India and Panama at 1½ shows a fall of 2s. 6d., and the First Preference are ¼ weaker at 10½.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, May 31st.	Closing Quotation, June 7th.	Business done during week ended June 7th, 1899. Highest.	Lowest.
124,400*l*	African Direct Telegraph, 4 % Debs.	100	...	...	...	101 —105	101 —105	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560*l*	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	61 — 63	61 — 63	...	...
3,047,220*l*	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	112 —113	112 —113	112¾	112⅛
3,047,220*l*	Do. do. Deferred...	Stock	...	...	18s. %	13 — 13½	12¾— 13¼	13 1/16	...
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15½— 16	15½— 16	15¾	15½
75,000*l*	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	110 —114	110 —114	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	185 —195	185 —192	...	...
1,332,523*l*	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105½	...
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½%	...	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9½— 10½	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	...	102 —105%	104	103
60,710*l*	Direct United States Cable	20	3 %	3½%	...	11¼— 11¾	11½— 12	11 11/16	11⅝
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	102 —105	102 —105	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	...	165 —170	165 —170	168½	167
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	100 —104	100 —104	...	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	101 —104	101 —104	...	...
1,432,268*l*	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	116 —120	118 —122	119½	119
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	16½— 17	16½— 17	16 13/16	16 11/16
16,200*l*	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	100 —104	100 —104	...	...
64,400*l*	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	101 —104	101 —104	...	...
320,000*l*	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	121 —125	120 —124	120	...
35,100*l*	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	100 —104	100 —104	...	...
46,500*l*	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	101 —104	101 —104	...	...
300,000*l*	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	102 —105	102 —105	...	...
200,000*l*	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102—105%	102 —105%	...	...
180,227	Globe Telegraph and Trust	10	4½%	4½%	5⅛%	11¾— 12¼	11½— 12	12	11⅝
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15¾— 16¼	15½— 16	15⅝	15⅜
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	31½— 32½	31½— 32½	...	...
92,600	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	101 —104	101 —104	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	54 — 57	53 — 56	54½	...
100,000*l*	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	108 —111	108 —111	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½%	6 %	6 %	4½— 5	4½— 5	4 1/16	4⅝
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4¾— 5¼	4¾— 5¼	...	...
1,329,471*l*	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	99 —102	100 —103	101	99⅝
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1	⅞— 1	1	...
100,000*l*	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	105 —108	105 —108	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8 xd	7 — 8 xd	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	131 —136	131 —136	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4¾— 5¼	4¾— 5¼	...	...
151,733*l*	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000*l*	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	103 —106	103 —106	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	106 —109	106 —109	...	...
88,321	West India and Panama Telegraph	10	1 %	⅝%	...	1½— 1⅝xd	1⅜— 1⅝	1½	...
84,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 11 xd	10¼— 10¾	10 9/16	10¼
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½xd	8½— 9½	...	...
80,000*l*	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	105 —108	105 —108	...	...
158,100*l*	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	11 — 12	11 — 12	11½	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5¾— 6¼	5¾— 6¼	6	..
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	8 — 9	8 — 9	8 7/16	8⅛
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	4½%	...	114 —116	114 —116	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	16½— 17½	15½— 16½	17⅞	15 15/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	15 — 16	15 — 16	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	126½	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	*nil*	11 — 12	11 — 12	11⅝	11¼
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14 — 15	14 — 15	14	...
220,000	Do. 4½% Deb. Stock, Prov. Certs (£60% to be paid) Rd.	...	...	...	...	54 — 56	54 — 56	...	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	...	5¼— 5⅜	5¼— 5⅜	...	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	8 — 9	7½— 8½	8½	7 15/16
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3¾— 4¼	3¾— 4¼	4	3⅞
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6¼— 7	6¼— 6¾	6¾	6⅝
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	106 —108	106 —108	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	16¼— 17¼	16¼— 17¼	17	16¾
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	15½— 16½	15½— 16½	...	...
220,000*l*	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	118 —121	118 —121	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	16 — 17	16 — 17	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	17 — 18	17 — 18	17¾	17⅜
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	4½— 4⅝	4½— 4⅝	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½— 15½	14½— 15½	15⅜	15

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation May 31st.	Closing Quotation June 7th.	Business done during week ended June 7th, 1899. Highest	Lowest
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	3 — 3½	3 — 3½	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	18½— 19½	18½— 19½	19⅛	18 15/16
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	13¾— 14¼	14 — 14½	14 7/16	14⅛
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	13½— 14	13¾— 14¼	14 3/16	14⅛
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	127 —130	128⅜	128¼
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	1⅞— 2⅛	1⅞— 2⅛	1⅞	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2¼— 2½	2¼— 2½	2⅜	2 5/16
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	113	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	103 —106	103 —106	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13 — 14	13½— 14½	...	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	114 —117	114 —117	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10⅜— 11¼	10½— 11	11¼	...
178,303	Do. do. do. £8 paid	10	...	...	...	8⅝— 9¼	8½— 9	9⅛	9
61,033	Do. do. Pref. half-shares £3 paid	...	...	...	...	3¼— 3⅜	3¼— 3⅜	...	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	5⅜— 6¼	5½— 6	6	...
630,000*l*	City and South London Railway	Stock	1 1/16 %	1⅞ %	2⅛ %	68 — 70	67 — 69	68½	68¼
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £5 pd.	10	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3⅜— 4¼	3⅜— 4¼	3⅞	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	98 — 101	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½%	6 %	...	2 — 2½	2 — 2½	2¼	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½%	6 %	...	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	96 — 98	96 — 98	98	97
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2¼— 2½	2¼— 2½	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝— ⅞	⅝— ⅞	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	...	10 — 12	10 — 12	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	25 — 26	25 — 26	25¼	25
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18 — 20	18 — 20	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	112 —115	112 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21 1/16	21½
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	101 —105	101 —105	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞ %	3¼ %	3¼ %	8⅝— 8⅞	8⅝— 8⅞	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	14 — 14½	14 — 14½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	39⅞	38½
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	105 —108	105 —108	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¾— 10¼	9¾— 10¼	9¾	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5¾— 6¼	5¾— 6¼	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	105 —108	105 —108	107½	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10½.
British Aluminium, Ordinary, 10½—11; 7 % Pref., 12—13.
House-to-House, 4½% Debentures of £100, 105—108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8½. Debentures, 107—110. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 6s.—8s.
Smithfield Market Electric, 3—4.
*T. Parker, £10 (fully paid), 16.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, June 7th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	32/-	32/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	37/-	37/-	..
a Ammonia, Muriate (crystal) .. per ton	£26	£26	..
a „ „ .. .. per ton	£24	£24	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£26 15	£26 15	..
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a „ White Sugar .. .. per ton	£31	£30 10	10s. inc.
a „ Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3¾d.	3¾d.	..
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6 10	£6 15	5s. dec.
a „ Recovered .. .. per ton	£5 10	£5 15	5s. dec.
a „ Lump .. .. .. per ton	£5 0	£5 5	5s. dec.
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a „ Crystals .. .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	3d.	3d.	..
METALS, &c.			
b Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£65 to £137	£65 to £137	..
c Brass (rolled metal 2' to 12') basis per lb.	8½d.	8½d.	..
c „ Tube (brazed) .. .. per lb.	10½d.	10½d.	..
„ Wire, basis .. .. per lb.	8½ d.	8½ d.	..

METALS, &c. (*continued*).	This week.	Last week.	Increase or Decrease.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f „ Sheet .. .. .. per lb.	6/-	6/-	..
g Copper Bars .. .. .. per ton	£80	£80	..
g „ Wire (basis price) .. per lb.	10½d.	10½d.	..
g „ Sheet .. .. .. per ton	£80	£80	..
g „ Rod .. .. .. per ton	£80	£80	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/1½	4/1½	¼d. inc.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	60/4	59/5	11d. inc.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 .. per ton	£10 7 6	£10 7 6	..
g Lead, English Ingot .. .. per ton	£14 12 6	£14 12 6	..
g „ „ Sheet .. .. per ton	£15 7 6	£15 7 6	..
l Mica (uncut slabs 8" long) .. per lb.	6/8	6/8	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 5	£8 5	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd strip & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£115	£115	..
g „ foil .. .. per lb.	1/6	1/6	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/7	1/7	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £65	£40 to £65	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7½d.	7½d.	..
j „ Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j „ Hemp, 3 ply 10 lbs. .. per lb.	3½d.	3½d.	..
j „ „ Russian, 10 lbs. per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove .. per ton	£12	£12	..
j „ Manila, 24 thread .. per ton	£32 10	£32 10	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£31 10	£31 10	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
l Messrs. Sanders, Wake & Co.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

THE HAYTHORN WATER-TUBE BOILER.

IN the Haythorn water-tube boiler the form and arrangement of the tubes is novel and quite distinct from that of any other boiler. These boilers were first fitted on one of the steamers of the Caledonian Steam Packet Company in 1898, and are said by the *Engineer* to have run satisfactorily ever since. Similar boilers have now been fitted to the *Lorna Doone* paddle steamer of the Southampton and Isle of Wight Royal Mail Steam Packet Company. In the Haythorn boiler the section longitudinally with the grate shows at the top near the boiler front a steam shell of considerable diameter. This extends right across the boiler, and it is connected along its lower part to a series of slightly inclined vertical headers, 12 in number, which extend downwards at much the same slope, and to the same extent, as the headers of the Babcock boiler. From these headers there extend backwards 14 tubes, while from the lower end of the header a single tube extends downwards, but curves at once backwards and parallel with the other 14 tubes, thereby forming a space between the lowest of the 14 and itself. This space bounded by 24 tubes above and below forms a flat combustion chamber. At a distance of 4 or 5 feet all the tubes commence to curve downwards, the centre of curvature being the same. Hence the top tubes have a total length of 14 feet 6 inches, and the lower ones of 8 feet 4 inches. When they have curved nearly 90° they all continue vertically downwards about 18 inches and enter a series of 12 horizontal headers at a level just below the back ends of the grate bars. There are thus two tubes to each header. The tubes are mostly 2 inches diameter, but 96 of them are 3½ diameter, namely, each of the sets of 24 tubes bounding the combustion chamber, the top row of tubes and a row in the middle of the headers, all the four rows of larger tubes serving as division plates, in place of the slabs of firebrick usually arranged. The furnace is thus not roofed in brick, and the combustion chamber is not surrounded with brick. The course of the gases is towards the back of the furnace, and between the single row of lower tubes into the combustion chamber, thence among the main body of tubes from front to back, passing under the division tubes, close down to the back header, and among the upper half of the main body of tubes to the front header, and away to the chimney. A boiler as described has a heating surface of 2,400 square feet, and a grate of 42·4 square feet.

Each of the 12 elements of 30 tubes weighs 14 cwt., and the boiler, as a whole, contains 2·8 tons of water, and weighs, as a whole, 21½ tons. The arrangement of the combustion chamber is such as should greatly diminish the smoke, if not entirely prevent it, with suitable auxiliary air admission. The curvature of the tubes will provide for expansion without undue stresses, and the general arrangement is good. We have no particulars as to the rate of combustion and evaporative efficiency, but so far as safety is concerned, we should anticipate that the Haythorn boiler will prove very much more safe than boilers of the Belleville type, where the tubes are so very flat, and are in too long a series with each other. If water-tube boilers are to become an assured success, we think they will be found to have curved tubes, and these of small diameter. In the *Lorna Doone* the ratio of grate to heating surface is 1 to 56·6, and owing to the peculiar configuration of the tubes the gases have a considerable length of travel parallel with the tubes, and not so entirely across them.

The tubes are pitched 3½ inches apart, and as the larger tubes are 3½ inches diameter they practically form the divisions named above of the combustion chamber and in the centre of the main body of tubes. But these larger tubes are reduced in diameter at their ends where necessary to admit the passage between them of the gases. By this arrangement the usual slabs of firebrick are avoided, an advantage as regards wear and tear and maintenance, but as regards the combustion chamber probably a disadvantage, though possibly the lower set in this chamber might be plastered up with clay. The curved form of the tubes necessitates the use of the larger tubes, for firebrick slabs could not well be applied on the curved and vertical portions. A certain amount of the gases must, however, pass through even the narrow spaces between the larger tubes, though perhaps no more than through the brickwork slabs when such become damaged by wear.

The Haythorn boiler is a distinct improvement on boilers of the Belleville type.

THE AMERICAN TRUST MOVEMENT AND THE BRITISH MANUFACTURER.

WE have referred several times in our issues of the last few months to the growth of the Industrial Trust movement in America, and to the probable effects of the change upon the manufacturing industries of that country. To-day we return to this subject to emphasise one of the points named in our earlier articles, namely, the over-capitalisation which is known to be occurring in connection with the movement.

In this country we have had considerable experience of the type of consolidations now so popular in America, and though in one case —that of the English Sewing Cotton Company—the results have been financially successful, in two others the consolidations have been failures, and there are few who would deny that this failure has been chiefly due to over-capitalisation at the time of the transfer.

But it is not necessary to depend upon instances of over-capitalisation which have occurred in this country. The Americans are themselves awakening to the fact that a great inflation of capital is accompanying these new developments; and, in proof of this, we give two extracts from American papers:—

"A manufacturer turned over his plant to one of the recent industrial combinations, and took cash therefor. This plant was represented by something like $1,000,000 stock, which was turned over. The stock had not paid him a dividend in some years, and 12 months ago he would willingly have accepted 10 cents on the dollar for it. He received, however, in actual cash from the new combination something over par. It may further be mentioned *that this same interest is to be represented by something like* $5,000,000 *of new capital in the new company.* He hopes that the buyers of these five millions new capital will do better with it than he did in the past."—*Electricity*, March 29th, 1899.

"Many of our leading industrials are now in the hands of speculators, schemers and promoters. It is no uncommon thing for them to form a combination of manufacturing industries, representing a total cash value of, say, $5,000,000, and incorporate it for some fifty millions. They pay a promoter from five to ten millions for his services, then they issue a lot of common stock and divide this around among the manipulators. The stock is then placed upon the market, boomed with favourable announcements, so as to run the price up to 75 or par, and sold to investors. The stockholders must take their chances on the future, and many of these companies, before the organisation, were making very small dividends or even running at a loss. The stock is so watered that it is impossible to pay fair dividends upon the increased capitalisation. It simply means that the investors are fleeced."—The *Commercial*, New York, February, 1899.

The economies resulting from centralisation and improved management, will not, we believe, balance the charges arising from an inflated capital account, and we are, therefore, expecting to hear that the prices of manufactured goods in the United States have considerably increased. In some industries advances of 10 to 40 per cent. have already been notified to customers. "It is an ill wind that blows no one good," and though we must regard the Trust movement as bad for America, it will certainly make things easier for the British manufacturer. The high tariff will, of course, prevent him from competing to any great extent in America, even when helped by the general rise of prices which we expect; but in the neutral markets of the world his position will be more secure, and in these we hope that for some time to come he will benefit by the manner in which New York financiers and stock-brokers have over-weighted the manufacturing industries of their country.

AUSTRALIAN ELECTRICAL NEWS.

[FROM OUR SPECIAL CORRESPONDENT.]

Sydney, *April 29th*, 1899.

THE George Street Electric Tramway is really showing signs of progress, and the residents of Sydney are looking forward to being able to travel by it before the end of the year. The permanent way has long been in position and also the poles for the trolley wires, and the trolley wire is lying waiting in the car house; at the power house, though as yet there is no roof, the electric travelling cranes are in place and being utilised for the erection of the first instalment of the generators and engines; the foundations are completed and portions of engines and generators in place. For the first instalment of the work four sets of generators are being put in, each of 850 kilowatts capacity, consisting of General Electric multipolar generators direct connected to E. P. Allis compound horizontal engines arranged in two rows with a crane over each row. The engines have 26-inch and 48-inch cylinders with a 4-feet stroke and run at 100 revs., and are made alternately right and left-handed so that one condenser does for two engines; the generators have 12 field poles, the armatures weigh 21 tons each, and the fly-wheels are 20 feet in diameter and weigh 40 tons. The circulating pumps are Blake centrifugal, and feed pumps Blake three-throw plunger, all electrically driven, and air pump for the Wheeler condenser are Blake steam driven. The travelling cranes have a span of 48 feet, each motion is controlled by a separate motor, G.E. 800 standard railway type being used for travelling and hoisting, and a 25-H.P. General Electric L.W.P. type for the traverse; all motors being series wound with rheostatic control, their lifting capacity is 30 tons each. The engine room is capable of extension in the direction of the rows for an ultimate capacity of 20 similar sets, or about 24,000 H.P. in all. The boiler house alongside is arranged in the same manner with a row of boilers each side and capable of extensions parallel with the engine house; the first instalment of boilers will consist of 14 in two rows, of which one row of seven is already in place and ready for the brickwork. The boilers are multitubular, of 300 H.P. capacity each, 16 feet long and 7 feet diameter, with 72 tubes of 4 inches diameter, 22 of which are stayed and 50 plain, and six stays are used in the steam space; the boiler settings are fitted with Alve's patent hot air economisers. The chimney stack is 200 feet high and 6 feet diameter. The switchboard, which will be fixed on a gallery at the end of the building next the offices, is already made and will shortly be on its way; the first portion will be 39 feet long, and will have four generator panels, one summation panel, two accummulator panels, one lighting panel, and 10 feeder panels, and is, of course, capable of extension along the whole width of the engine room, *i.e.*, 100 feet.

The accumulators will consist of a set of 300 K-23 and 300 K-9 E.P.S. cells. The car house has accommodation for 108 cars. This

power house is not being constructed entirely for the George Street line, but is to ultimately supply the necessary power for all lines as fast as they are converted from steam to electric. The George Street line, which consists of 3¼ miles of double track, has a return feeder of 500,000 circular mils. section laid between each pair of rails and connected to each alternate rail on either side, and the two are cross-connected every six lengths of rail, and at about the middle of the line the four rails and two feeders are connected to nine similar cables which take a short cut to the power house underground; the line being U-shaped, the distance to the power house by this short cut is about half a mile, whereas by the track it is about a mile and a quarter; various bonds are used: Edison-Brown plastic, Edison-Brown plug, Chicago, Bryan, and a special bond devised by the Tramway Construction Department. The line feeder cables are Callender Company's, and are laid in Callender bitumen concrete conduit with drawing-in boxes at about every 100 yards.

The estimated cost of the line was £130,000, and up to the present the following tenders have been accepted:—

Excavations for power house (H. Pollock)	£886
Erection of power house and offices (J. Stewart & Co.)	19,797
Chimney stack (Phippard Bros.)	2,365
Car house (J. Stewart & Co.)	12,490
Steel columns and girders for power house (R. L. Scrutton)	1,040
Conduit for supply of water (J. McSweeny)	3,895
Steam engines and generators (H. H. Kingsbury) ...	38,119
Steam boilers (G. & C. Hoskins)	4,718
Setting of boilers and fixing of coal handling apparatus (J. Stewart & Co.)	7,135
High pressure steam piping (H. W. Peabody & Co.) ...	1,450
Cast-iron and other piping (H. Vale & Sons)	2,119
Covering for steam piping (Wm. Adams & Co.) ...	330
Pumps and spares (H. P. Gregory & Co.)	3,360
Switchboard and connections (H. H. Kingsbury) ...	2,750
Cables for station wiring (I.-R. & G.-P. Company) ...	777
3 spiral staircases for power house (Clyde Eng. Co.) ...	130
Overhead travelling cranes (H. W. Peabody & Co.) ...	2,228
Accumulators (Wm. Adams & Co.)	1,749
Permanent way, George Street section (Willmott & Morgan)	25,000
„ Harris Street section (J. McSweeny) ...	12,754
Poles (Foreign Agency Company)	1,735
Pole bases and arms (Hudson Bros.)	
Trolley wire (C. Kolling)	775
Cables for return conductors (C. Kolling)	2,553
Conduit and feeder cables (Callender Company) ...	3,617

Making a total cost to date of £139,772, but of course the whole of this amount must not be credited to the George Street line alone, as the present plant is intended to work also the North Shore lines, and there are some items which do not belong wholly to the George Street line costs.

It has been definitely decided to at once push on with the conversion of the whole of the steam tramways to the electric system, and a commencement is being made with the lines to the western suburbs. The electric lighting committee of the Sydney Municipal Council has now completed its deliberations, and it is generally understood that their report will recommend the Council to at once make use of the powers already granted to them by the Legislative Assembly; whether the Council will adopt the measures recommended in the report is quite a different thing as the gas company's interests are known to be very strongly represented on the Council.

ELECTRIC TRAMWAY SYSTEMS AS FREIGHT DISTRIBUTORS IN CITIES AND SUBURBS.

In a recent issue of *Sell's Commercial Intelligence*, a comparatively new weekly journal devoted to the promotion of British trade and industry, the attention of electrical engineers is drawn to the fact that in Brooklyn the electric street car system is being used for the carriage of coal and other heavy freight during the night. A double advantage is gained, for not only is the congested day traffic of the streets relieved, but a practically continuous load is obtained for the generating stations. It is suggested that the organising of such a scheme of freight distribution by the tramway system in the larger English cities would be less difficult than in America, since most of the larger systems on this side are under municipal management, and the governing bodies when once their sanction was obtained, would do all in their power to render the plan a success. The writer of the article alluded to even thinks that branch lines might be laid to act as feeders to the main system. He says:—

"There is no reason why the tramways in England, now equipped or soon to be equipped with electricity, should not be similarly used, and connected wherever possible with the railways and the docks. It would be an easy matter for manufacturers, warehousemen, and large shopkeepers to connect their places with spur lines; to load their merchandise during the daytime, and have it transported over the electric street railways between midnight and 5 o'clock in the morning, when passenger traffic in most English cities is suspended. The municipalities could also use the street car lines at night for many of their services, such as the removal of street sweepings and snow, and the distribution of road making and road-repairing materials. It ought to be possible, too, for coal merchants to distribute their supplies at night by means of the trolley lines."

In busy cities it would undoubtedly be an enormous gain to have effected silently and expeditiously during the night, a transfer of goods and merchandise, which at present occurs with excessive dirt, noise, obstruction, and discomfort during the day. But we cannot see that the idea is practicable, if it involves the laying of branch tracks and feeder systems all over our larger towns. The capital expenditure upon these extensions would make the cost of the new method of transit too high. We rather think that a solution will be found for the problem in the design of *freight trailer cars* which can be run either on the tramcar rails or on the ordinary roads. Such trailer cars would then be loaded as at present and taken by horse or manual traction to the nearest point of the electrical tramway system, where they would be picked up by the first train of freight cars going in the desired direction.

We commend the idea to the attention of firms engaged in the manufacture of electric passenger cars in this country; as we feel convinced that were successful cars of this type designed and built, they would be quickly adopted, and would be found of immense service in the distribution of raw materials and manufactured goods in many of our larger cities.

THE REPORT OF THE PACIFIC CABLE COMMITTEE.

In the examination which we propose to make of the Report of the "Committee appointed to consider the proposal for laying a telegraph cable between British North America and the Colonies of Australasia," it appears to be best to divide the subject out as was done in the instrument of appointment of the Committee, in which the following questions were advanced for consideration, and for report to Her Majesty's Government:—

I.—Is the laying of such a cable practicable from a technical point of view?

II.—If so, what route should be selected for the cable?

III.—What will be the cost (*a*) of laying, (*b*) of maintaining, the cable, and (*c*) of the annual working expenses?

IV.—What revenue will arise from the traffic which may be expected to pass over the cable?

V.—Should the cable be owned and worked by Government or by a subsidised private company?

VI.—If the cable were to be national property, what would be the proper method of management and administration?

VII.—What should be the form of contract offered to a contractor for its construction?

The desire is also expressed that the Report should embody the views of the Committee "on any subsidiary questions of a practical nature which may arise during the investigation." The letter of appointment is dated June 2nd, 1896, and is signed by the Right Hon. J. Chamberlain.

The members of the Committee were the following:—

The Right Hon. William Waldegrave Earl of Selborne, Under Secretary of State for the Colonies; George Herbert Murray, Esq., C.B., a principal clerk in the Department of the Treasury*; Sir Donald Alexander Smith, G.C.M.G., High Commissioner for Canada†; the Hon. Sir Mackenzie Bowell, K.C.M.G., Member of the Privy Council of Canada‡; the Hon. Sir Saul Samuel, K.C.M.G., C.B., Agent-General for New South Wales§; and the Hon. Duncan Gillies, Agent-General for Victoria‖.

The Committee met in Downing Street on June 5th, 1896, and was then adjourned until October 26th, as the Telegraph Conference then being held at Buda-Pesth necessitated the absence of some of the delegates. Thus it was not until November 12th that the Committee began to take evidence, and we may say here that as all the evidence given was expressly stated to be "confidential," nothing, presumably, was known of its nature to those who were not present at the sittings until the publication of the report in April last, some two and a half years later. During the examination of witnesses the Committee had the advantage of the advice of Sir Sandford Fleming, K.C.M.G., and of Messrs. J. C. Lamb, C.B., C.M.G., and W. H. Preece, C.B., F.R.S., the two latter representing the Postmaster-General.

* At present secretary to the Post Office.
† Now the Right Hon. Lord Strathcona and Mount Royal.
‡ Resigned before the Committee began to take evidence, the Hon. A. G. Jones being appointed in his place.
§ Since retired from Agency.
‖ Since retired from Agency.

The secretary to the Committee was Mr. W. H. Mercer, of the Colonial Office. During the 13 days which were passed in taking evidence, the following 26 witnesses were under examination:—Mr. Sandford Fleming, formerly engineer-in-chief to the Canadian-Pacific and to the Intercolonial Railways, acting as expert adviser to the Canadian representatives; Mr. M. H. Gray, submarine cable engineer-in-charge of the Silvertown Telegraph Company; Mr. Alexander Siemens, a director of Messrs. Siemens Bros.; Mr. Theophilus Smith, chief submarine cable engineer of the Henley Telegraph Company; Mr. F. R. Lucas, engineer-in-chief to the Telegraph Construction and Maintenance Company; Dr. Alexander Muirhead, joint inventor of the "duplex method," and of electrical apparatus; Mr. H. A. Taylor, partner in the firm of Clark, Forde and Taylor; Capt. W. Goodsall, late commander of the Eastern Telegraph Company's ship *Chiltern;* Mr. W. H. Preece, engineer-in-chief and electrician to the General Post Office; Rear-Admiral W. J. L. Wharton, hydrographer-in-chief to the Admiralty; Mr. Frederick Ward, manager in England of the Commercial Cable Company; the Marquess of Tweeddale, chairman of the Eastern Extension Telegraph Company (examined conjointly with Messrs. H. A. C. Saunders and F. E. Hesse); Mr. J. C. Lamb, third secretary of the General Post Office; Mr. H. Buxton Forman, controller of packet services of the General Post Office; Mr. J. H. Carson, manager of the Anglo-American Telegraph Company; Mr. R. K. Gray, engineer-in-chief and assistant to the managing director of the Silvertown Company; Mr. T. Playford, Agent-General for South Australia; Mr. W. P. Reeves, Agent-General for New Zealand; Mr. W. H. Mercer, of the Colonial Office (secretary to the Committee); Mr. B. T. Ffinch, director-in-chief of the Indo-European Telegraph Department of the Government of India; Mr. N. Cork, managing director of the Commercial Bank of Sydney; Mr. C. U. Kingston, secretary to the Australian Mortgage, Land, and Finance Company; Colonel Hozier, secretary of Lloyds; Mr. E. T. Doxat, chairman of Dalgety & Co., Limited.

Besides the evidence given by the gentlemen above named, a considerable volume of statements, memoranda, &c., put in by witnesses and others is appended to the report. We now reprint the report *verbatim* before dealing with some of the evidence upon which it is based, and discussing the conclusions arrived at.

The report runs as follows:—

1. The Committee have the honour to report that, having been appointed by the Secretary of State for the Colonies on June 2nd last, they held their first meeting on the 5th of that month; but that owing to unavoidable delays they were unable to begin the examination of witnesses until November 12th.

2. The Committee desire to express their obligations to Mr. Sandford Fleming, whose long labours on the subject of a Pacific cable have thrown much light upon the project and materially facilitated the task of the Committee, and to all the gentlemen who have been so good as to give evidence and whose answers range over the whole ground comprised in the reference to the Committee.

3. The Committee have carefully considered these answers and other materials bearing on the subject which have been laid before them, and have the honour to report as follows upon the questions submitted to them.

4. The Committee consider that the most convenient course will be for them to deal with the points submitted to them in the same order as laid down in the Instrument of Appointment.

I.—Practicability.

5. No one disputes the practicability of the project from a technical point of view, although the depth, probably in places over 3,000 fathoms, is as great as that in which any cable has hitherto been laid. The Committee consider that a preliminary survey is indispensable, principally for the purpose of ascertaining, before the cable is laid, and of avoiding, while it is being laid, any serious inequalities in the bed of the ocean which might cause "suspension," and in course of time fractures, of the cable. Such a survey could, however, be made while the cable is being manufactured; it could be made by the contractors under the supervision of an officer appointed for the purpose by the owners of the cable; and the necessary provision for it, with all proper conditions, could be contained in the contract. The present information with regard to the route is sufficient for the purpose of estimating the expense of the cable, and it may be assumed that the further survey recommended would not lead to any material variation in the tenders.

6. Further, it will be necessary that a careful examination be made of the various islands to be presently mentioned with a view to ascertaining the best spots available for landing stations.

II.—Route.

7. The Committee recommend that the route should be from Vancouver *vid* Fanning or Palmyra Island, Fiji, and Norfolk Island, with branches from the last-named station to Queensland and New Zealand. No doubt there would be a decided advantage in taking the cable *vid* the Hawaiian Islands, instead of *vid* Fanning or Palmyra Island, as the section would in that case be shorter, and therefore less costly for the same speed, or faster for the same cost, and some traffic would, if no line is laid from California, be obtained from Honolulu. But this route would involve a departure from the principle of using only British territory for landing stations, and as this principle has been formally endorsed by the Canadian and Australasian Governments at the Conferences at Ottawa and Sydney the Committee consider that it should be adhered to, and that a departure from it would be a material change in the character of the scheme which was approved at those Conferences.

8. The length of the cable over the route recommended would be, allowing 10 per cent. for "slack" actually used, about 7,986 nautical miles, viz:—

Vancouver to Fanning Island, 3,561, or a little less from Vancouver to Palmyra Island;
Fanning Island to Fiji, 2,093, or a little less from Palmyra Island to Fiji;
Fiji to Norfolk Island, 961;
Norfolk Island to New Zealand, 537;
Norfolk Island to Queensland, 834.

9. The Pacific cable as a means of communication between Australasia and Europe would be, of course, dependent on the landlines across America and on the trans-Atlantic cables; and it would be necessary for it to have some working arrangement with them. Such arrangements are universal in the case of submarine cable companies, which must obviously make terms with the landlines by which their traffic is received or forwarded. The only telegraph line which at present runs from the eastern seaboard to Vancouver is that of the Canadian Pacific Railway Company. This company is in connection at Canso in Nova Scotia with the Commercial Cable Company, which possesses three cables from Great Britain to Canso; and the nature of the arrangement between them is shown in the telegraphic correspondence contained in the Appendix to this Report. The Commercial Cable Company is an American company, but all the landing stations are on British territory. It is stated that the other trans-Atlantic cable companies, whether British or foreign, are in connection and alliance with the Western Union Telegraph Company, which is also an American company.

10. The Western Union at present effects its junction with the Canadian Pacific Railway Company's telegraph lines at Montreal, but it is highly probable that were a Pacific cable laid from Vancouver to Australia it would (if it does not already possess such a connection) make its own connection with Vancouver through the United States territory as far as British Columbia.

11. The effect of this position of affairs is, that the choice of routes would lie between an American cable company having its stations exclusively on British soil and in connection with a land system passing over British territory and controlled by a British company, and cable companies which, whether British or American, and which, whether possessing stations on British or American soil, are in connection with a land system controlled by an American company, and possibly passing through the greater part of its length over American territory.

III.—Cost.

12. The cost of laying the cable depends mainly on the materials used in it; and, as the quality of these can be tested, the question is practically one of quantity. The outer coverings are much the same in all specifications, according to the conditions of the case, but the conductor of copper and the insulator of gutta-percha vary in quantity in proportion to the speed of transmission required, and, therefore, the question of cost practically depends upon them, the heavier the cable in these respects the greater being the speed and the cost. With regard to all the sections, except the long one from Vancouver to Fanning Island, opinions as to the composition of the cable do not much vary, and as the speed of the whole line is limited, for through traffic, to that of the longest section, it will only be necessary to go into particulars with regard to that section.

13. On this branch of their inquiry the Committee have taken a large amount of technical evidence from electrical experts. This evidence has been in some important respects conflicting, and the Committee have been obliged to form their own conclusions, weighing one authority against another.

14. The principal points which the Committee have had to consider are:—

1. The weight per nautical mile of the core best suited for the purposes of the long section.
2. The theoretical speed of transmission obtainable from a given core over a given distance.
3. The deductions which have to be made from the theoretical speed of transmission to arrive at the actual practical speed in "paying" letters.
4. The number of hours per diem during which a cable can be worked for commercial purposes.

The Core—15. The cores recommended to the Committee varied from 500 lbs. copper and 320 lbs. gutta-percha (Mr. Siemens) to 800 lbs. copper and 550 lbs. gutta-percha (Mr. Preece, of the General Post Office), but the Committee have decided to select for detailed consideration from between those limits, two types, which have been recommended from different points of view.

16. The first would contain 552 lbs. copper and 368 lbs. gutta-percha, and was that recommended to the India-rubber, Gutta-percha and Telegraph Works Company by Lord Kelvin in November, 1895.

17. The Committee do not consider that it would be wise economy to lay down a cable of any lighter type than this. The speed of transmission would be reduced to too low a figure.

18. The second would contain 650 lbs. copper and 400 lbs. gutta-percha, and is that which was adopted for the cable laid by the

Anglo-American Telegraph Company in 1894. There is a serious mechanical difficulty in handling cable of very heavy weight at great depths, and the Committee are of opinion that it would not be prudent in any case to lay a cable of a heavier core than this over the long section.

Speed, Theoretical and Practical.—19. It is, however, in connection with the speed obtainable from a given cable over a given distance that the opinions of the experts have differed most materially.

20. For instance, Dr. A. Muirhead gave it as his opinion that a cable of 552 lbs. copper and 368 lbs. gutta-percha over the long section would, with experienced operators, and by the use of the automatic curb method of transmission, give a speed of 80 letters per minute, and similarly, for a cable of 650 lbs. copper and 400 lbs. gutta-percha, 95 letters per minute.

21. Mr. Preece, on the other hand, stated that the same core as that last named, over the same distance, and by the same process, would give a speed of not quite 63 letters per minute.

22. For the same cable Mr. M. H. Gray, Mr. Lucas, speaking for himself and for the late Admiral Sir George Richards, and the representatives of the Eastern Extension Telegraph Company, estimated a speed of 70 letters per minute.

23. On the other hand, Mr. Siemens estimated the same speed of 70 letters per minute for a cable of 500 lbs. copper and 320 lbs. gutta-percha, while for a cable of 800 lbs. copper and 550 lbs. gutta-percha, Mr. Preece estimated a speed of 85 letters per minute.

24. Lord Kelvin wrote to the Committee that, in his opinion, they might reckon on getting 60 letters per minute, and that possibly they might get 80 letters per minute, out of a cable composed of a core of 552 lbs. copper and 368 lbs. gutta-percha over the long section.

In all cases the speed given was the theoretical speed for simplex working.

25. On the questions of the deductions which have to be made to reduce the theoretical to the practical speed, the divergence of opinion was not less remarkable.

26. The explanation of this is to be found in the fact that much depends upon the system on which a line is worked. Thus, in the case of the trans-Atlantic lines, where the competition is very keen and the hours of business comparatively limited, and where the regulations of the International Telegraphic Convention do not apply, it has been found possible to reduce the non-paying traffic to about 16 per cent.

27. On the other hand, on the Eastern lines the proportion is much higher, because the reserve power of the lines is very great, and therefore there is more margin for non-paying traffic, the working hours are practically longer, and the regulations of the International Convention have to be followed. Mr. Preece estimated that a theoretical speed of nearly 63 letters per minute for the core of 650 lbs. copper and 400 lbs. gutta-percha would be reduced in practical working to 28 paying letters per minute. Mr. Lucas stated that a theoretical speed of 70 letters per minute for the same core was equivalent to four or five paying words a minute. Mr. Lamb, of the General Post Office, said that a deduction of 55 per cent. must be made from the theoretical to find the practical speed of a given cable. Mr. Ward, manager of the Commercial Cable Company, calculated that a total allowance of 16 per cent. should be made for "dead" traffic; Mr. Carson, of the Anglo-American Telegraph Company, 15 per cent.; and Mr. Gray, of the India-rubber, Gutta-percha and Telegraph Works Company, about 17 per cent. Mr. T. B. Ffinch, director-in-chief of the Indo-European Telegraph Department of the Government of India, and having charge of the telegraphs from Karachi up the Persian Gulf and through Persia, stated that the average number of service indications which have to be forwarded with a message of 12 paying words of a length of eight letters each, would, on the average, be equivalent to 10 letters. Furthermore, he stated that the unavoidable use of the lines under his charge for administrative purposes would amount to less than 5 per cent. of the whole traffic. His estimate, therefore, of the total unavoidable "dead" traffic amounts to about 17 per cent.

By the theoretical speed of a cable the Committee understand the maximum number of words which can be transmitted in a minute so that an experienced operator can certainly and easily read them. The practical speed is the proportion of that maximum number which remains after certain deductions have been made for the transmission of words for which no revenue is received and for loss of time.

28. The Committee ascertained that these deductions were made on account of—

1. Service indications and prefixes, such as station of origin, number of message, time, date, &c.
2. Repetitions, errors in transmissions, corrections.
3. Necessary intervals between the messages, time lost by clerks, &c.
4. Administrative messages connected with the traffic.

There are, of course, other administrative messages which must necessarily be sent on the business of the line, but these could, in most cases, be left for periods when there was no traffic for transmission.

29. It must also be borne in mind, in considering this question, that though the speed of a cable is usually stated as being a certain number of words per minute, these words are "reputed" words of five letters each. In actual practice a word averages eight letters, the increase being due to the use of code words, and to the omission of many conjunctions and prepositions when messages are sent "in clear."

30. The so-called "words," however, which have to be added to each message as service indications and prefixes, do not consist generally of more than two or three letters each.

(To be continued.)

ALUMINIUM FOR SWITCH WORK, BUS BARS, &c.

By ERNEST KILBURN SCOTT.

(*Continued from page* 879.)

THE following table is based on well authenticated figures, and is for wires to give equal conductivity. The present prices of the two metals are assumed to be 10¼d. a lb. for bare copper wire and 18¼d. for bare aluminium wire of approximately about ⅛ inch in diameter.

	Relative conductivity.	Relative area for equal conductivity.	Relative weight for equal conductivity.	Weight of one mile of wire in lbs. for equal conductivity.	Present price per lb.	Total price one mile of wire to give equal conductivity.
Copper ...	100	100	100	·1 inch dia. 162·3	10¼d.	£6·93
Aluminium	60	160	48	·123 inch dia. 77·9	18¼d.	£5·9

Quotations have been given in America for aluminium wire at as low as 15d. per lb., and as the price of copper is some six or seven pounds a ton higher over there than it is with us, the comparison is much more in favour of aluminium. Of course, on account of the boom in trade, all metals have increased in price, but aluminium has been affected only slightly, and there is certainly no likelihood of its going higher.

There is, however, one point which tells against aluminium at the present moment, and that is the limited demand. Whilst the price of copper remains fixed at 10¼d. a lb., whether it is ordered in 40 or 5 ton lots, the price of aluminium may vary from 18¼d. for the higher quantity to 21d. a lb. if under 5 tons is required, this being necessary to allow a margin for the special setting of the machinery. In any case 77·9 lbs. at 21d. a lb. only comes to £6·81 for one mile of ·123 diameter wire, and on referring to the table it will be seen that even this is lower than copper.

Aluminium lines have been installed at the Chlorate of Potassium Works and the Hydraulic Power and Manufacturing Company, of Niagara, also the Snoqualmie Falls Power Company, and the Standard Electric Company, of California, with the best results, and it has been found that the snow and ice load is practically the same although the cross-section is greater.

The present rise in copper is principally aimed at the electrical industries, and it is, therefore, to our interests to give such a fillip to the employment of aluminium as a conductor as will help to break the back of this threatened monopoly. Unfortunately power transmission lines are few and far between, but aluminium might very well be given a fair trial for trolley lines especially as orders for many miles of wire must of necessity be placed within the next few months. Possibly the increased contact surface for the trolley wheel will be found of advantage. It is interesting to note that 67 tons weight of bare aluminium feeders are to be used for the North-Western Elevated Railroad of Chicago. The feeders are to be in three sizes, the largest being about 1½ inches in diameter. They are to be laid in the Crompton fashion in wooden troughing, being supported at intervals of 9 feet by vitrified blocks. The contract has been accepted on the basis of 47 lbs. of aluminium being equivalent in conductivity to 100 lbs. of copper.

ABSORPTION AND CABLE SPEEDS.*

THE tabular statement of actual and calculated speeds of working through Atlantic cables issued by Messrs. Siemens Bros. in January, 1898, has lately been brought into prominence by the repeated reference made to it by Mr. Alex. Siemens and by the accuracy of certain figures being called in question by the managing director of the Telegraph Construction and Maintenance Company.

* Publication delayed for want of space in our last issue.

In order that our readers may the more readily follow the claim and the objections raised to the figures put forward to substantiate it, we reprint this table, which has already appeared in the Electrical Review, June 3rd, 1898, p. 786.

done in every case, excepting the 1894 "Anglo" cable, for which the speed has been calculated by dividing the same constants given above by the K R where R is the measured conductor resistance as *laid*, and not at 75° F., as in the other instances. The speed, on this account, should be 26·99 and

Actual and Estimated Speeds of Trans-Atlantic Cables.

Tabular Statement drawn up by Messrs. Siemens Bros.:—

1 Date when laid.	2 Designation of cable.	3 Length in nautical miles.	4 Type of core of deep sea cable. Lbs. per naut. mile.	5 K R, Ohm × Microfarads / 10^6	6 Calculated speeds taking 1874 cable at 20·2 words per minute.	7 Calculated speeds taking 1874 cable at 27·6 words per minute.	8 Speeds actually obtained in regular working.	9 Calculated speed if lengths 1,850 naut. miles.	10 Calculated speed if lengths 1,850 naut. miles and core 650·400.	11 Manufactured by
			Cop. G.P.							
1873	Anglo-American ...	1,876	400/400	3·919	18·11	24 75	...	...	...	Tel. Const. & Mtnc. Co.
1874	Anglo-American ...	1,837	400/400	3 512	20 20	27·6(*f*)	20·2 (*a*)	19·9	28 2	Tel. Const. & Mtnc. Co.
1875	Direct United States	2,423	400/360	7·558	9·38	12·82	22·6 (*b*)	38 6	70·2	Siemens Bros.
1879	Pouyer-Quertier ...	2,242	350/300	6·600	10 74	14·67	22 (*c*)	32·2	59·8	Siemens Bros.
1866/80	Anglo-American ...	1,852	...	4·632	15 31	20·91	...	...	...	Tel. Const. & Mtnc. Co.
1 81	Jay Gould	2,518	350/300	7·834	9 05	12 37	21·5 (*d*)	39 8	69 4	Siemens Bros. & Co.
1882	Jay Gould	2,563	350/300	8·030	8 84	12·08	21·5 (*d*)	41·2	71 2	Siemens Bros. & Co.
1884	Mackay-Bennett (S.)	2,353	350/300	6·740	10·52	14 37	26	42·0	72·3	Siemens Bros. & Co.
1884	Mackay-Bennett (N.)	2,346	350/300	6 630	10 71	14·63	26	41 8	71 2	Siemens Bros. & Co.
1894	Mackay-Bennett (3rd)	2,161	500/320	4 671	15 18	20 74	40 (*g*)	54 6	77 2	Siemens Bros. & Co.
1894	Anglo-American ...	1,850	650/400	2 420	29·31	40 04	47·4 (*e*)	47·4	47 4	Tel. Const. & Mtnc. Co.

(*a*) Report of engineers, Messrs. Clark, Forde & Co., to the manager of the Anglo-American Telegraph Company, dated June 25th, 1877.
(*b*) Report of engineers, Messrs. Clark, Forde & Co., to the manager of the Direct United States Cable Company, dated June 25th, 1877.
(*c*) Report of the engineer-in-chief, Mr. von Chauvin, to the Pouyer-Quertier Cable Company, dated June 15th, 1880.
(*d*) Report of Dr. Muirhead to Mr. von Chauvin, representative in London of the Western Union Telegraph Company, dated July 10th, 1883.
(i.) Special trial of code words, 18 words per minute } mean
(ii.) Press messages, usual rate, 25 " " " } 21·5
(iii.) As many as 135 letters per minute have been observed to pass at times without requiring repetition.
(*e*) *Electrician*, dated October 12th, 1894.
(*f*) Speed specified as basis for column 7 is taken from a letter from the manager of the Anglo-American Telegraph Company, dated September 20th, 1894.
(*g*) From a letter from Mr. G. G. Ward, vice-president and general manager of the Commercial Cable Company, dated May 10th, 1895.
It will be noticed in col. 8 that the actual working speed obtained with the cables made and laid by Siemens Bros. & Co., is very much greater than that calculated upon, even allowing for all the progress in manipulation and manufacture. Cols. 9 and 10 prove this even more clearly, the figures given there having been calculated (from actual speeds) according to well-established formulæ—col. 9 showing what the speed would be if all the cables were only 1,850 nautical miles long, and col. 10 if the length and weight of core of all the cables were the same as those of the 1894 Anglo Cable.

The claim by Messrs. Siemens for certain advantages in point of speed possessed by their cable core is of a somewhat earlier date, as will be seen from the following extracts from the Proceedings of the Pacific Cable Committee, November 17th, 1896, p. 43:—

Chairman: I think, Mr. Siemens, you said that you proposed per nautical mile 500 lbs. weight of copper and 320 lbs. gutta-percha, and that, you calculated, would give a speed of 15 words per minute?

Mr. Siemens: Yes.

Chairman: Well, we had evidence yesterday of a proposal of 522 lbs. copper and 368 lbs. gutta-percha, calculated to give a speed of 12 words per minute. How can you explain that discrepancy?

Mr. Siemens: Ah, I am very glad I have brought the evidence to show you; that is, that we are of opinion that our cables are very much better, through reasons that I do not want to tell, than anybody else's, and, if I may, hand you this table—this is a comparison of speeds of the Atlantic cables.

Something concerning the nature of the advantage claimed we gather from the discussion of Mr. Elton Young's paper at the Institution of Electrical Engineers on April 27th last, when Mr. Siemens is reported to have stated that the great problem which cable makers had before them was to reduce this "spongy factor" of the capacity, if he might so call it, as much as possible, and that this was possible, was clearly demonstrated by a table of cable speeds of the Atlantic cables published some time ago by his firm, which showed that all cables did not follow the K R law. How very important it was to pay attention to this spongy factor of the capacity might be seen if they compared the two latest Atlantic cables made in England, viz., the 1894 "Anglo," and the 1894 "Commercial" cables.

Turning to the figures given in the above table, we notice that the speed of working through the 1874 Anglo-American cable is taken as a standard of comparison for the other cables. The *constants* for cols. 6 and 7 are respectively $70{\cdot}95 \times 10^6$ and $96{\cdot}94 \times 10^6$, *i.e.*, the product of the total capacity (609·88 mfds.), and C.R. at 75° F. ($5{,}759^{\omega}$) multiplied by the speed 20·2 for col. 6, and 27·6 w.p.m. for col. 7.

These speeds were obtained on the 1874 cable as *laid*, that is, with its conductor at a much lower temperature (say 35° F.), and not at 75° F.; therefore to obtain the speed of another cable having the same mean bottom temperature, these *constants* must be divided by the K R of the cable, where R is the total resistance also at 75° F. This has been 36 87 instead of 29·31 and 40·04, as given in cols. 6 and 7 for the 1894 "Anglo" cable.

Assuming the correctness of the speeds in col. 8 for regular working, the calculated values in col. 9 are as given. We have endeavoured to check the calculated speeds in col. 10, and, subject to small differences arising from the actual capacity or the values of log. $\frac{D}{d}$ for the differing forms of conductor used not being stated, the figures appear rather too high compared with the 1894 "Anglo" in all cases, and especially in the case of the D.U.S. 1875 cable. To assist comparison it would have been well to give in the Table the capacity and conductor resistance from which K R has in each case been arrived at.

It is not stated whether col. 10 has also been corrected for the difference between the specific conductivity of the copper used for the earlier and later cables, which is an important consideration if the figures in this column are to be taken as a proof of increased speed due to the reduction of *absorption*. If it has been so corrected the relative specific conductivities should be given so that the values may be checked in this particular also.

The first and most important question which suggests itself is, Are the speeds given in col. 8 really comparable and reliable? for if not, the whole comparison in col. 10 becomes worthless.

If 27·6 w.p.m. for the 1874 "Anglo" cable is a proper basis for speed calculation—see note (*f*) of table—then all figures in col. 6 are much too low. Mr. Siemens evidently thinks 27·6 is too high, because he prefers to give, in col. 8, the regular working speed actually obtained as only 20·2 w.p.m.

This does not seem reasonable, in view of the working speeds in actual practice being in every case much higher still (col. 8) even than the figures in col. 7. On this head Mr. Shuter, managing director of the T. C. and M. Company, informs us that carefully timed counts made on the Anglo Company's cables, and published in the *Electrician*, November 30th, 1894, showed a speed 50 per cent. higher than the earlier figures of June 25th, 1877, which statement is more than borne out by col. 8, in which the regular working speed is in almost every case over 100 per cent. higher than the calculated values in col. 6. Again, if the speeds in

col. 8 are worthy of credence, neither 20·2 nor 27·6 w.p.m. for the 1874 cable are suitable as bases of comparison; and why the 1874 cable should have been selected as a standard, in preference to some other cable whose working speed has been more reliably ascertained, is not clear. The only use of cols. 6 and 7 in the table is apparently to show how widely the results calculated by the K R law differ from those actually obtained in practice as given in col. 8; but if that is their object, the proof is not very convincing, because, if we look at the figures in cols. 7 and 8 for the several Siemens's cables, we notice that the ratios between the calculated and actual speeds follow the K R law, in nearly all cases, as much as could be expected, considering the uncertainty as to what is really the "regular working" speed for each of them. At any rate, they cannot be said to disprove that law. Any differences are, we think, more likely to be due to the working speed of the several cables not having been made by the same operator and obtained under absolutely comparable sending and receiving conditions.

Mr. Siemens has probably taken one of the higher speeds obtained, no doubt during a long trial, on the 1894 "Commercial" cable, made by his firm, as the regular working speed. In col. 8 of the table this is given as 40 w.p.m., whereas Mr. Shuter refers to a letter from Mr. G. G. Ward—the same authority as invoked by Mr. Siemens—in which the working speed is given as only 32 w.p.m.; while Mr. F. Ward in his evidence before the Pacific Cable Committee in November, 1896, stated that under pressure they could work up to 34 w.p.m. Between 34 and 40 words there is certainly a very considerable difference, and, as far as we can form an opinion, this would seem to be in a great measure the explanation of the remarkable difference in speed assigned by Mr. Siemens to the two 1894 cables.

Supposing, however, that we accept Mr. Siemens's tabulated figures in col. 8 as correct and comparable, we are still left in doubt as to what we are to attribute the differences shown in col. 10 between the speeds reduced from col. 8 for the same length and size of core; for while Mr. Siemens tells us in the discussion on Mr. Elton Young's paper that all cables do not follow the K R law, we are, on the other hand, told in a footnote of this table that the results have been calculated from actual speeds "according to well-established formulæ." If it be true that all cables do not follow the K R law, how can we accept the values in col. 10, which are entirely based on that law; for if the K R law has introduced errors into the results, col. 10 cannot safely be taken as reliable evidence of the importance and advantage of reducing absorption and thereby improving speed, which we take to be the object of the table. If, on the contrary, col. 10 is based on "well-established formulæ," and the working speeds in col. 8 are trustworthy, there would no doubt be some ground for the claim that the difference between the "Anglo" and "Commercial" 1894 cables is due to certain improved methods of manufacture employed by Messrs. Siemens Bros., more especially in paying strict attention to the "spongy factor" of capacity. In that case it would appear that this improved process has been known to that firm for at least 24 years, judging by the high speed of 70·2 w.p.m. assigned in col. 10 to the 1875 D.U.S. cable, and has nevertheless all these years escaped notice, and therefore been unappreciated. If the differences are really capable of this explanation, how is the marked difference between the speeds of the 1879 and 1875 cables (both made by Messrs. Siemens Bros.) to be explained, the earlier cable having a much higher speed than the one four years later?

We confess that the tabular comparison is too involved in uncertainty to bring conviction, and fails to do so, chiefly, perhaps, because it attempts to prove too much.

Any disparity due to inertia of the recorder coil for speeds so similar as 40 and 47 w.p.m., or any difference due to unequal self-induction in the two cables, cannot be held accountable in any important degree for the widely different speeds given for the 1894 "Anglo" and "Commercial" cables, and allowing a generous amount for any increase due to reduced absorption, there still remains a considerable margin, which we are disposed to attribute, in a great measure at least, to the fact that the "regular working" speed is too vague an expression, and that the values given for these two cables were either not obtained under precisely comparable conditions, or that the signals recorded were not equally good.

Since writing the above comments, which could not be included in our last issue for want of space, we notice that in a letter to the *Electrician* of June 2nd, Mr. Alex. Siemens replies to Mr. Shuter's objections to what he considers the misleading comparison of the relative working speeds of the 1894 Anglo and Commercial cables as given in the above Table.

While recognising the mistake made in regard to the K R value of the 1894 Anglo cable which, when corrected for temperature makes a difference of 8 per cent. in favour of the Anglo cable, Mr. Siemens remarks that "that does not account, by a long way, for the whole of the differences in speed." He, moreover, reminds us that none of the speeds are results of special trials with a view to compiling the Table, but that the authority has been given in every instance for the various statements regarding the working speeds assigned to each cable; and, further, that comparison has not only been made with the 1874 Anglo according to the report of Messrs. Clark, Forde & Taylor (June 25th, 1877), but also with the speed given in a letter from the manager of the Anglo-American Company, September 20th, 1894, and with the speed of the 1894 cable in the *Electrician*, October 12th,* 1894, which speeds do not differ from those given in the article, November 30th, 1894,† quoted by Mr. Shuter, so that all the data available at the time were utilised.

In answer to Mr. Shuter's objection to 40 w.p.m. being adopted in the Table (col. 8) as the speed of the 1894 Commercial, in view of the statement made by Mr. F. Ward before the Pacific Cable Committee, "That under pressure they (the Commercial Cable Company) could work up to 34 words per minute,"—Mr. Siemens refers to the following questions and answers in the Report of that Committee:—

1,628. Can you tell the Committee how many paying words per minute your experience shows you you can get out of that cable, that is after deducting all the signals that do not pay—all the service signals?

Yes; well, we calculate the amount of work by five-letter words you see.

1,629. Give me in letters then, the number of letters?

No, I do not recollect. I should like to be positive about that, as far as I can; I think we can do about 34 five-letter words a minute duplexed under ordinary pressure.

1,630. That is under pressure including everything; 34 five-letter words a minute?

Yes; that is we can work up to that.

Mr. Siemens concludes that "Mr. Shuter has evidently only looked at answer No. 1,630, and has not noticed that the speed of 34 words refers to ordinary pressure and to duplex‡ working."

To make quite sure what was meant, Mr. Fred. Ward was applied to, and he confirms that during the time of day when most messages are handed in, and to which he meant to refer by the words "ordinary pressure" in his answer No. 1,629, the cable is used duplex‡ at the rate of 34 five-letter words per minute, but that there is no difficulty in obtaining a higher speed if found necessary.

In this connection we may remark that the accuracy of the comparison between the 1894 Anglo and Commercial cables clearly depends to a very great extent on what may fairly be considered the *working speed* of both these cables. *Ordinary pressure*, though an indefinite term, would seem to imply an approximation at least to their proper working speed limit or a "good for traffic" standard, and anything beyond it would necessarily approach an unusual pressure, since Mr. Siemens points out that "none of the speeds in his Table are the result of special trials."

The 34 words referred to by Mr. Shuter would, therefore, appear the more reasonable figure instead of 40 words per minute.

No doubt "there would be no difficulty in obtaining a

* † The authorities here referred to give for the Anglo cables the following results:—

Cable.	Mr. A. Dearlove, Oct. 12th, 1894. Actual working speed.	Mr. P. B. Delany, Nov. 30th, 1894. Highest speed with regular traffic
1873 ...	... 28 words ...	... 149 letters per minute.
1874 ...	... *28 „ ...	... †149 „ „
1880 ...	... 24 „ ...	... 129 „ „
1894 ...	... 47·4 „ ...	... 243 „ „

‡ Mr. Dearlove states that the 47·4 w.p.m. for the 1894 Anglo cable were also obtained with duplex connections, as were the speeds given by Mr. Delany, and in the absence of any note to the contrary we assume that the figures in col. 8 are all comparable in this respect. —Eds. Elec. Rev.

higher speed if found necessary" on *all* the cables included in the Table than the *working speed* given, but that is scarcely to the point, because unless strictly representing the working speed in each case, the results in col. 10 would not be comparable.

Mr. Siemens explains that his "object in raising the whole question at the recent meeting of the Institution of Electrical Engineers was to obtain, if possible, an explanation of the discrepancy in speeds which remains even when the figures given in Mr. Shuter's letter are used as basis; for it must be granted that if the third Commercial cable were 1,847 nautical miles long, *i.e.*, of the same length as the 1894 Anglo cable, instead of 2,161 nautical miles, its speed would be increased from 34 to $34 \times \frac{2{,}161^2}{1{,}847^2} = 46{\cdot}6$ words per minute; and its K R would be diminished from 4·22* to 3·15. In other words, this shortened cable would give practically the same working speed as the 1894 Anglo cable, although the K R of the latter is only 2·41, or about two-thirds of the K R of a cable of the same length, but with the core of the third Commercial cable. As this core consists of 500 lbs. copper and 320 lbs. gutta-percha per nautical mile, while the core of the 1894 Anglo cable contains 650 lbs. copper and 400 lbs. gutta-percha per nautical mile, the scientific importance of this difference is self-evident and well worth the attention of all students of electricity."

We entirely concur that the question thus clearly stated is of great importance and requires investigation. Mr. Siemens has already told us what his explanation is, in his evidence before the Pacific Cable Committee given above. Although at that date Mr. Siemens did not wish to reveal the secret, at the Institution of Electrical Engineers he was disposed to be more communicative and referred to col. 10 of his tabulated speeds of the Atlantic cables as evidence of the great importance of paying attention to the "spongy factor" of capacity, the reduction of which was the great problem cable manufacturers had before them. The value of the table and of this explanation of the cause of speed difference is, however, discounted by his having expressed the opinion that all cables do not follow the K R law, on which col. 10 is entirely based.

Whether the K R law is at fault, and to what extent, still remains to be proved; and whether the same method of reducing the recorded results to five-letter words per minute has in each case been identical requires verification. At any rate the first step towards it should, as we have elsewhere suggested, be by removing all incomparable elements by a practical trial, using the same automatic transmitter and receiving instrument to ascertain, as near as the characteristic signals of the two cables permit, the speeds for each cable which give the same size and definition for the same words. If, then, the fact be clearly demonstrated that the Siemens cable has distinctly a higher speed, no doubt the theoretical explanation will soon be forthcoming. In the meantime it would be of great assistance if Messrs. Siemens Bros. would kindly supply the total resistance either at 75° F. or at sea temperature, and also the total capacity of all the Siemens' Atlantic cables included in his Table, from which the K R values have been derived; and especially the electrical data of the three Commercial cables which do not appear to have been yet published. We should also be glad to learn from Mr. Siemens how the very high speed of 70·2 words per minute in col. 10 for the 1875 D.U.S. cable can be accounted for, since the speed of their 1879 Brest-St. Pierre cable shows only a calculated working speed of 59·8. If the 34 words, instead of 40, be adopted for the third Commercial cable, it will be found that the calculated speed for this, the latest of the Siemens cables, must be reduced from 77·2 (in col. 10) to 65·6, that is, its speed works out appreciably below that of their 1875 D.U.S. cable, and, indeed, of all their others, except the 1879 P.Q. cable given in col. 10.

Electro-Harmonic Society.—Mr. C. E. Grove having been elected honorary secretary of the above Society, members are requested to address communications to him at "Rosedale," Selsdon Road, Cambridge Park, Wanstead.

* This is given in the Table, col. 5, as 4·671.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, *to whom all inquiries should be addressed.*

10,699. "Improvements in and connected with street lamp-posts electric light standards, and the like." W. Jones. Dated May 23rd.

10,726. "Improvements in electrical switches." B. Thomas. Dated May 23rd.

10,744. "Storage batteries." E. L. Lobdell. Dated May 23rd. (*Complete.*)

10,768. "Improvements in electric arc lamps." The British Thomson-Houston Company, Limited. (R. Fleming, United States.) Dated May 23rd. (*Complete.*)

10,769. "Improvements in means for electrically igniting gas." F. W. Goldby. (La Société Anonyme, "Lux Nova," Belgium.) Dated May 23rd. (*Complete.*)

10,791. "Improvements in electric lighting apparatus." A. Plecher. Dated May 23rd. (*Complete.*)

10,815. "Improvements in incandescent electric lamps." C. L. R. E. Menges. Dated May 23rd. (Date applied for under Patents, &c., Act, 1883, Sec. 103, October 27th, 1898, being date of application in France.) (*Complete.*)

10,817. "Improvements in terminals and binding screws for electric batteries and connections." W. R. Edwards. Dated May 23rd.

10,839. "Improvements in automatic electric cut-out devices for electric cooking apparatus." F. W. Schlindler. Dated May 24th.

10,843. "Improvements in concentric electrical fittings." S. T. Robinson. Dated May 24th.

10,860. "Improvements in or relating to shunting devices applicable for use on electric cars and the like." E. Andreas. Dated May 24th.

10,863. "Improvements in electric switches." B. Hopkinson. Dated May 24th.

10,877. "An improved method of and arrangement for protecting the anti-cathode in Röntgen tubes." C. H. F. Muller. Dated May 24th.

10,892. "Improvements in electrical warp stop-motions for looms." W. H. Baker and F. E. Kip. Dated May 24th. (*Complete.*)

10,903 "Improvements in telegraphic transmitters and receivers." W. L. Wise. (A. C. Crehore and G. O. Squier, United States.) Dated May 24th.

10,911. "Improvements in primary batteries." A. Pfannenberg. Dated May 24th. (*Complete.*)

10,922. "An improved relay for magneto-bells." J. G. Whittle. Dated May 25th.

10,978. "Improved telephone switch." A. E. Lamkin and J. G. Lemon. Dated May 25th.

11,010. "A water-proof lampholder for Swan incandescent electric lamps." H. D. Fitzpatrick. (G. Brandt, Germany.) Dated May 26th. (*Complete.*)

11,012. "Improvement in the construction of electro-motors." W. Peck. Dated May 26th.

11,024. "An improved electrical switch and fuse." H. C. Gover and C. W. Cox. Dated May 26th. (*Complete.*)

11,097. "Improvements in sockets or holders for incandescent electric lamps." A. Vandam and T. H. Marsh. Dated May 27th. (*Complete.*)

11,101. "Improved methods of utilising high potential electric spark gaps." B. H. Thwaite. Dated May 27th.

11,105. "Relay apparatus for closing a subsidiary circuit of an electrical installation when a current in the main circuit has a certain strength or voltage." Siemens Brothers & Co., Limited. (Siemens and Halske, Aktien Gesellschaft, Germany.) Dated May 27th. (*Complete.*)

11,106. "Improvements in synchronised electric clocks." Siemens Brothers & Co., Limited, and E. F. H. H. Lauckert. Dated May 27th. (*Complete.*)

11,110. "Improvements in electric switches." A. M. Clark. (The General Incandescent Arc Light Company, United States.) Dated May 27th. (*Complete.*)

11,117. "Improvements in quadruplex and multiplex telegraphy and to apparatus for use in connection therewith." S. G. Brown. Dated May 27th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free,* 9d. *(in stamps).*

1897.

12,210. "Improved means for supplying current to electric railway and tramway vehicles." R. Demeuse. Dated May 17th, 1897.

Relates to electric railways and tramways on a road contact or sectional conductor system with continuous or polyphase currents and electro-magnetically operated switches. Collectors.—A long collector is built up of bars pressed down by buffers. Switches, Conductors.—A derived current from the collector flows through the forward exposed contact to a fine wire coil magnet and to earth, thereby lifting the armature. This action breaks the earth circuit and completes the main circuit between the main conductor and contact through the thick wire coil magnet. The contacts on the armature are wedge-shaped, and take between plates which are pressed together by springs. The whole is mounted in a closed box surmounted by the stud which is insulated from it. In a modification, the fine wire coil magnet is carried by the vehicle, and throws a bell-crank armature in the box. For a three-phase current, the circuits contain two collectors and two studs for each switch box. The cores of the magnets are formed of coils in the circuits, but otherwise the construction of the switch is similar to that of the first described method. 5 claims.

20,923. "Improvements in electric heaters." E. E. Gold. Dated September 11th, 1897. Heaters of air, water, oil or other fluids are made with resistance wire coiled into a small helix, which is itself generally coiled to form a large helix. This is supported internally or externally by open supports, so that all parts of the wire are exposed in an approximately equal degree to the fluid to be heated. The wires, or preferably the supports, are covered with thin insulation, such as vitreous enamel. Various supports are specified. In one arrangement the helix is held in helical grooves in segmental insulators placed in a tube. The tubes may be in halves bolted together, and either solid, to convey liquids, or slotted, to admit free passage of air to be heated, when the tube is fixed horizontally under the seat of a railway carriage, or elsewhere. In modifications of this arrangement the helix may fit in a helically grooved perforated tube of insulating material, or in or on a corrugated metal tube. In a second arrangement the helix, A, encloses one or more insulated supporting wires, which are secured at their ends by nuts to discs. 17 claims.

21,109. "Improvements in the bobbins and cores of solenoids for enclosed arc lamps." W. J. Davy and G. Thomas-Davies. Dated September 14th, 1897. Relates to arc lamps. Solenoids and cores for enclosed arc lamps are specially constructed for use with alternating or rectified current. An air-tight tube to carry the winding consists of sheets of thin German silver and asbestos paper or cloth, wound on a mandrel, and connected by shellac varnish or cement; the asbestos breaks the metallic circuit round the tube. A core is made up of strips of iron perforated to receive wires, by which they are connected into cylindrical form on a tube. Asbestos washers may be placed between the strips to reduce noise. 3 claims.

21,366. "An improved electric arc light reflector." C. M. Bolles. Dated September 17th, 1897. An arc lamp is provided with a reflecting shade carried by an annular band and two hinged semi-circular plates, which fit upon the lower edge of a conical casing, and are secured by clasps. A circular opening and slots in the reflector permit it to be passed over the lamp. 1 claim.

21,534. "Improvements in electric arc lamps." B. J. B. Mills (E. Leconte, France.) Dated September 20th, 1897. The upper carbon is carried by a rack in gear with a pinion on a toothed wheel which engages the pallets of a balanced weight. This is pivoted centrally in a lever frame pivoted in the lamp frame, and connected to the core or armature of a series solenoid or electro-magnet. The pinion and wheel are carried in a light frame free to slide on two vertical rods; its movement is limited by adjustable nuts and the top of the lamp frame, a cushion being provided. The balance rests on the base of the lamp frame, and the pallets are clear of the wheel, so that the upper carbon rests on the lower one. When current passes, the core and lever lift the pallets into gear with the wheel after which the lever lifts the frame until a vertical arm of the balance engages a stop fixed adjustably on the lamp frame. Rotation of the wheel is thus prevented, and the arc is struck. When the core and lever fall so far that the arm of the pallet leaves the stop, the wheel can rotate under control of the balance, permitting the rack and carbon to descend. The transparent or translucent arc enclosing globe fits loosely in a conical socket and carries a fixed cap, closely fitting the upper carbon. The cap has several chambers formed by cups, which are connected by screwing or frictionally; each may be provided with a valve opening outwards. In another arrangement, the arc enclosing globe is fixed, and a cap made with chambers is movable laterally upon it. 14 claims.

22,217. "Improvements in shielding devices for electric meters." The British Thomson-Houston Company, Limited. (E. Thomson, United States.) Dated September 28th, 1897. Motor meters having permanent magnetic brakes are provided with means to prevent alteration of the strength of the magnets by the accidental passage of excessive currents through the main coils of the meters. Either the magnets or the coils, or both, are enclosed, or partly enclosed, by non-magnetic closed conducting circuits, in which opposite currents are induced by any sudden variation in the main current, and the strong magnetic field of the latter thus limited. One arrangement is applied to an energy meter, in which the main current field coils are surrounded by parallel copper conductors, made either solid or of wire. Such shields may be otherwise arranged near or between the layers of the coils, or round the brake magnets and disc. 5 claims.

22,276. "Improvements in electrical propulsion of barges and boats on canals and rivers." H. W. Handcock and A. H. Byers. Dated September 29th, 1897. Relates to an arrangement of apparatus for propelling and steering barges and boats on canals and rivers, in which is a rudder carrying a motor driving the shaft of a screw propeller by bevel gearing. The current for working the motor is collected by a trolley pole, the roller of which makes contact with an overhead wire. A suitable switch is provided on the tiller. In a modified arrangement, the motor casing forms the rudder blade proper, and instead of a spring coupling a flexible shaft connection is provided. 4 claims.

22,800. "Improvements in electrical apparatus for use in dental surgery and other electro-surgical treatments." W. E. Dow. Dated October 5th, 1897. Electric and magnetic appliances, surgical.—Relates to electric apparatus for use in dental surgery and other surgical operations, comprising means for administering anæsthetics to the organ under treatment, for cauterising purposes, for magnetic exploration, &c. In the box are arranged three cells of a dry battery, the terminals of which are connected to the several contacts of a switch for throwing one or more of the cells into or out of circuit. The terminals of the switch are connected with binding posts for receiving the ends of a double conductor which may be connected with a sponge for application to the surface of the body and an electrode to be applied to the organ under treatment, for example, a tooth. In order to provide for a gradual regulation of the current, a rheostat is included in the battery and switch circuit This consists of an insulating cylinder, helically wound with a bare resistance coil, and mounted upon a screw spindle so as to be capable of longitudinal movement within a conducting clip forming one of the terminals. A resistance switch may be arranged in shunt with the battery circuit for regulating the current in certain cases. Various forms of electrode are described. For introducing anæsthetics into a tooth cavity, the electrode consists preferably of a bundle of fine wires for carrying an absorbent pellet saturated with the anæsthetic. The shank fits into a handle composed of one or more conducting tubes with an insulating covering. Instead of a bundle of wires, a shank with an expanded end may be employed. For cauterising purposes the instrument consists of a metal tube and a conducting core embedded in insulating material, the tube and core being in electrical connection through a loop of platinum or like material. The metal tube is made in two parts, capable of being connected together by a spring button. An electro-magnet for exploring portions of the body, particularly the eye, and withdrawing magnetic bodies therefrom, consists of an elongated core terminating in a point and carrying a coil of insulated wire surrounded by a metallic protecting sheath. The ends of the coil are connected one to the sheath and the other to the core, the sheath and core forming the terminals. 13 claims.

23,057. "Improvements in and relating to electric railways on a sectional conductor system." E. C. Crocker and E. C. Howe. Dated October 7th, 1897. Electric railways and tramways on a sectional-conductor system, with electro-magnetic switches. Conductors—Switches: In each switch box are two pairs of magnets with an armature connected to two levers. One lever carries three contacts to connect up three pairs of contacts, and the other has two contacts for the two pairs. When the switches are thrown by the magnets the coils are simultaneously cut out. 3 claims.

23,296. "Improvements in indirect regulation of dynamo-electric machinery." W. Fairweather. (The Crocker-Wheeler Electric Company, United States.) Dated October 11th, 1897. Motors, controlling; dynamos regulating. The armatures are supplied with current by a constant current generator, and the fields by a constant potential generator and motor generator, and the regulation is effected by including in the field circuit a subsidiary dynamo which generates an electromotive force opposed to that produced by the armature of the motor generator. This subsidiary dynamo has its armature coupled to that of the motor, so that variations in the speed of the motor produce variations in the field excitation, whereby practically constant speed is maintained. The speed is regulated by a resistance switch in the field circuit of the motor generator. In a modification of this system, the motor generator is omitted, the field of the machine to be regulated and the armature of the regulated machine being connected up in series with the constant-potential circuit. In the method adopted for producing a constant current under varying load, the field of the constant-current generator is supplied by the armature of a subsidiary dynamo, the field of which is wound with two opposing coils, of which one is connected with a constant potential generator, while the other is in series with the armature of the main generator. The armatures of the two machines are mechanically coupled together. In a system for producing a constant potential under a varying load, a shunt-wound machine is employed. Its armature is connected in series with the whole or a portion of the field winding of the regulating machine; the shunt field winding of the machine to be regulated is connected in series with the armature of the regulating machine. 6 claims.

23,442. "Improvements in electrolytical current-directing devices and transformers." G. Y. Johnston. (C. Pollak, Germany.) Dated October 12th, 1897. In a cell having an aluminium electrode for stopping current tending to pass from this to a lead or other electrode, a solution of a chromate or soap is used as the electrolyte. It is stated that the aluminium electrode will keep in good condition in this solution with little wear. The use of such cells for preventing reversal in charging accumulators, and for rectifying alternating currents, is mentioned. 1 claim.

24,522. "Improvements in overhead lines of electric tramways or railways." P. Dawson. Dated October 22nd, 1897. Electric railways and tramways, with overhead conductors. Frogs for collectors, conductors. The underside of the frog plate has ribs, grooves, and guards, to guide the trolleys. In order to direct the trolleys on to the main or branch line, the grooves and the flanges of the trolley wheel are unsymmetrical for one line, and symmetrical for the other line; or grooves and flanges of different gauge, or other arrangements may be used. Preferably the ribs are curved and inclined upwards towards the centre, so that the trolley wheels run on their flanges at that point, but the plate may be inclined, &c. 3 claims.